VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

The five-year review process for the St. Louis FUSRAP sites began in January 2003 and continued through August 2003. The five-year review process included notifying regulatory agencies, the community, and other interested parties of the start of the five-year review; establishing the five-year review team in consultation with the USEPA and MDNR; reviewing relevant documents and data pertaining to the removal and remedial actions conducted at the SLS over the past five years; conducting site inspections; conducting site interviews; and developing/reviewing this first Five-Year Review Report. Each of these elements is discussed below.

Although the USEPA and MDNR had been informally notified that the five-year review process had begun for the SLS in advance, they were formally notified in a letter from USACE dated February 13, 2003. A conference call was held with the three parties on February 20, 2003 to discuss the establishment of the five-year review team, details of the site inspections and site interviews, and document review procedures.

The Five-Year Review Team consisted of the following members: Jacque Mattingly, USACE; Deborah McKinley, USACE; Daniel Wall, USEPA; Jill Groboski, MDNR; and JoAnne Wade, MDNR. Ms. Mattingly led the team in the site visits and interviews while Ms. McKinley led the team in preparing the Five-Year Review Report. Additional USACE, USEPA, and MDNR staff assisted in review of the report.

Community Involvement

Activities to involve the community in the five-year review were initiated in March 2003. On March 14, 2003, St. Louis District USACE representatives presented the scope and schedule of the five-year review at the St. Louis Oversight Committee meeting, which is open to the public. Information identifying the purpose, scope, and components of the five-year review and soliciting public comment was posted on the St. Louis-District Web site (www.mvs.usace.army.mil/engr/fusrap/home2.htm). This information was also presented in the St. Louis FUSRAP Sites newsletter that was issued to the site mailing list.

On March 31, 2003, a news release was sent to local newspapers, radio stations, and television stations advising that a review of radiological response actions was underway for FUSRAP sites. On September 2, 2003, a public notice was published in the St. Louis Post-Dispatch announcing that the draft five-year review report for the St. Louis FUSRAP Sites was complete and available for 30-day public review and comment at the FUSRAP Project Office and the St. Louis Public Library (Main and Olive branch). A news release announcing this was sent to the local newspapers, radio stations, and television stations.

Document Review

The following sections list the documents assessed as part of this five-year review. The documents are categorized into the following:

Basis for Response Actions

The documents listed in Table VI-1 identify the background and goals of the remedies and any changes in laws and regulations that may affect the response action. These documents also provide background information on the sites, basis for action, and clean-up levels, and address community concerns and preferences.

Table VI-1. List of Response Action Documents

Document	Property	Purpose	Use for Review
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Proposed Decontamination of the Vicinity Properties in the Vicinity of the Hazelwood Storage Site, March 1992 (DOE 1992).	HISS (VPs)	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
St. Louis Site Action Memorandum for Property Clean-ups, June 1995 (DOE 1995).	North St. Louis County sites VPs	Record selected response action.	Goal of remedy Basis for Action
St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA), September 1997 (DOE 1997a).	SLAPS	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material, September (DOE 1997b).	SLAPS	Record selected removal action	Goal of Removal Basis for Action
Record of Decision for the St. Louis Downtown Site, October 1998 (USACE 1998c).	SLDS	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Hazelwood Interim Storage Site (HISS), October 1998 (USACE 1998a).	HISS	Propose removal action alternatives	Goal of removal Background Basis for Action Clean-up levels Community Concerns
Action Memorandum for the Hazelwood Interim Storage Site (HISS), June 1998(USACE 1998b).	HISS	Record selected removal action	Goal of Removal Basis for Action
Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, March 1999 (USACE 1999a).	SLAPS	Record removal decision	Goal of removal Background Basis for Action Clean-up levels Community Concerns

Table VI-1. List of Response Action Documents (Cont'd)

Document	Property	Purpose	Use for Review
Feasibility Study for the St. Louis North County Site, May 1, 2003 (USACE 2003b).	SLAPS, SLAPS VPs, HISS	Propose remedial action alternatives.	Remediation Goals Background Basis for Action Community Concerns
Proposed Plan for the St. Louis North County Site, St. Louis, Missouri, May 1, 2003 (USACE 2003c).	SLAPS, SLAPS VPs, HISS	Presents preferred remedial alternative	Remediation Goals Background Basis for Action Community Concerns

Implementation of the Response

The documents listed in Table VI-2 furnish information about design assumptions, design plans or modifications, and documentation of the response action at the sites.

Table VI-2. List of Implementation Documents

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report Plant 1, St. Louis Downtown Site, December 9, 1999 (IT 1999b).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Plants 6 East Half and 6E, St. Louis Downtown Site, August 18, 2000 (IT 2000).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Midwest Waste – Vicinity Property (DT-7) FUSRAP St. Louis Downtown Site, May 3, 2001 (IT 2001a).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: Heintz Steel and Manufacturing Vicinity Property (DT-6), FUSRAP St. Louis Downtown Site, July, 28, 2000 (IT 2001).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: East End and Right-of-Way Work Areas, St. Louis Airport Site , July 2000 (Stone & Webster 2000).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.

Table VI-2. List of Implementation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report: Phase I Work Area, January 10, 2001 (Stone & Webster 2001a).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Phases 2 and 3 Work Areas, June 26, 2001 (Stone & Webster 2001b).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Hazelwood Interim Storage Site (HISS)-Main Pile Removal Action, December 2000 (USACE 2000d).	HISS	Record investigation data	Check whether contaminant levels meet criteria.

Operations and Maintenance

O&M documents describe the ongoing measures at the site to ensure the remedy remains protective at the site. The removal or remedial actions completed to date have allowed for unlimited use and unrestricted exposure at the property. Therefore, no O&M documents have been required. If institutional controls are necessary for release of property, O&M documents will be completed and discussed in subsequent 5-year reviews.

Response Action Performance

Monitoring data, progress reports, and performance evaluation reports listed in Table VI-3 provide information that can be used to determine whether the response action continues to operate and function as designed.

Table VI-3. List of Response Action Evaluation Documents

Document	Property	Purpose	Use for Review
VP-38 Removal Action Summary, Berkeley, Missouri, April 9, 2001 (USACE 2001d).	SLAPS VPs	Document that response actions are complete	History of VP-38 Status of VP-38 Chronology of activities
Annual Environmental Monitoring Data and Analysis Report for CY98, July 1999 (USACE 1999d).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), October 2000 (USACE 2000c).	SLAPS VP	Present final status survey data	Check whether contaminant levels meet criteria

Table VI-3. List of Response Action Evaluation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Radium Pits Removal Action Summary Report: FUSRAP St. Louis Airport Site, November 1, 2001 (USACE 2001e).	SLAPS	Document that construction activities are complete	History of SLAPS Status of SLAPS Chronology of activities Lessons Learned
Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri, September 1999 (USACE 1999b).	SLDS VP	Document that construction activities are complete	History of DT-2 Status of DT-2 Chronology of activities Lessons Learned
Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	SLAPS VPs	Document that construction activities are complete	History of St. Denis Bridge Status of St. Denis Bridge Chronology of activities Lessons Learned
Results of East Soil Piles and HISS Spoil Piles Characterization, St. Louis, Missouri, April 2000 (USACE 2000e).	HISS	Document that construction activities are complete	Characterization of soil
Final Post-Remedial Action Report for the Accessible Soils within the Downtown Site Plant 2 Property, January 2002 (USACE 2002a).	SLAPS	Document that construction activities are complete	Effectiveness of the remedial action at Plant 2
Final Status Survey Report Evaluation for the St. Louis Downtown Site City-Owned Property North (Metropolitan Sewer District (MSD) Salisbury Lift Station) Vicinity Property, February 2001 (USACE 2001f).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at MSD Salisbury Lift Station) VP
Final Status Survey Report Evaluation for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1), June 2002 (USACE 2002b).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at St. Louis Downtown Site ADM VP (DT-1)
Annual Environmental Monitoring Data and Analysis Report for CY99, June 2000 (USACE 2000f).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY00, June 2001 (USACE 2001g).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY01, June 2002 (USACE 2002c).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY02, September 2003 (USACE 2003e).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values

Legal Documentation

In October 1998, Congress transferred responsibility for the administration and execution of FUSRAP from DOE to USACE in the Energy and Water Development Appropriations Act, Pub. L. 105-62. Provisions of the appropriations acts for fiscal years 1999 and 2000 clarified Congressional intent that USACE should conduct FUSRAP activities subject to CERCLA and the NCP. In March 1999, USACE and DOE executed a Memorandum of Understanding (MOU), which identifies program administrative and execution responsibilities for the two agencies. USACE is currently conducting FUSRAP response actions at the SLS under the legislative authority in the appropriations acts; subject to CERCLA, the NCP, and Executive Order 12580 implementing CERCLA; in accordance with the FFA, originally negotiated between USEPA and DOE; and in accordance with the MOU. The MOU designated DOE as responsible for long-term stewardship. A team of USACE, DOE, USEPA, MDNR, and stakeholder representatives are cooperatively developing a long-term stewardship plan for conducting response actions, implementing institutional and access controls, performing O&M activities, and preparing five-year reviews.

Community Involvement

The Community Relations Plan helps give an understanding of the history of the community involvement and other activities at the SLS. Current community involvement actions are being carried out under the *Community Relations Plan for the St. Louis FUSRAP Sites, Rev. 3, January* (USACE 2001h). This document will be updated prior to the next five-year review.

Data Review

The data review component of this five-year review consisted of examining environmental monitoring data collected as part of response actions conducted at the SLDS and the North St. Louis County sites. An environmental monitoring program was implemented at the SLS in calendar year (CY) 1998. This program is an integrated monitoring program with sampling locations and frequencies defined on the basis of site-specific permits/permit equivalents, decision documents, and a commitment to be protective of human health and the environment and demonstrate short-term effectiveness pursuant to CERCLA.

Air, soil, sediment, surface water, and ground water are sampled and analyzed as part of the environmental monitoring program. A discussion of the review of these data by site is presented in the following paragraphs.

Environmental monitoring data are collected quarterly pursuant to Section XIV of the FFA; these data are not evaluated as part of the quarterly reporting. Therefore, the environmental monitoring program includes the preparation of an annual Environmental Monitoring Data Analysis Report (EMDAR) that consolidates and evaluates the environmental monitoring data. The annual reports are prepared by calendar year and summarize the data obtained during the calendar year and provide trend analyses of the data.

The environmental monitoring program is evaluated at the end of each fiscal year (FY). The result of this evaluation is the development of an annual environmental monitoring implementation program for the following FY. The sampling locations and activities of the program are not static because of the evolving nature of the response actions being conducted at the St. Louis Sites.

Accordingly, sampling activities may be deleted in subsequent FYs because the monitoring is no longer pertinent (e.g., perimeter airborne particulate monitoring would not be pertinent once a property had been remediated and the site restored). Conversely, an increased sampling frequency may be incorporated into the program to address an elevated intensity of response actions at a site. Sampling frequencies are driven by the sampling data collected. For example, if data trends indicate short-term increasing concentrations, the sampling frequency may be increased.

The data reviewed included those data presented in the post-remedial action or final status survey reports prepared at the completion of response actions. Data generated by response actions that are not complete were not reviewed. These data will be reviewed for the next five-year review report. Only the conclusions presented in the post-remedial action or final status survey reports regarding compliance with response action goals and future use of the property evaluated are presented in this report. For the complete analysis of the data, please refer to the individual post-remedial action or final status survey reports.

The data presented in the annual environmental monitoring data and analysis reports from CY1998 through CY2002 were also reviewed [*Annual Environmental Monitoring Data and Analysis Report for CY98* (USACE 1999d), *Annual Environmental Monitoring Data and Analysis Report for CY99* (USACE 2000f), *Annual Environmental Monitoring Data and Analysis Report for CY00* (USACE 2001g), *Annual Environmental Monitoring Data and Analysis Report for CY01* (USACE 2002c), and *Draft Annual Environmental Monitoring Data and Analysis Report for CY02* (USACE 2003e)]. Only a summary of the data evaluations is presented here. For a complete presentation and evaluation of the data reviewed, please refer to the annual environmental monitoring data and analysis reports for each CY.

Ground-Water Monitoring

Ground-water monitoring is conducted at the SLS to meet several general objectives. These objectives are to:

- determine background-water quality at each of the SLS;
- identify potential effects on ground-water quality resulting from removal and remedial actions;
- obtain requisite data to evaluate response action performance; and
- ensure compliance with the SLDS ROD (USACE 1998c) requirements.

Pursuant to the above objectives, comparison values were established to evaluate ground-water data obtained under the ground-water monitoring program for the SLS. These comparison values are derived from the SLDS ROD (USACE 1998c), environmental regulatory programs, and from North St. Louis County sites background conditions for shallow and deep ground water presented in the Feasibility Study (FS).

The regulatory-based values considered for evaluation of HU-A ground-water data from the SLDS are the MCLs, secondary MCLs (SMCLs), and MCL goals of the Safe Drinking Water Act.

The regulatory-based values considered for evaluation of all ground-water data from the North St. Louis County sites are the MCLs, SMCLs, and MCL goals of the Safe Drinking Water Act.

North St. Louis County sites ground-water data are also compared to ground-water quality criteria promulgated by the MDNR under 10 CSR 20-7 and health-based advisories for ground-water quality included under 10 CSR 20-7 Table A Class I and VII.

Beginning in CY2000, North St. Louis County sites ground-water data were also compared to background values developed for the North St. Louis County sites FS (USACE 2003b). Background values for just the hydrostratigraphic zone of interest (HZ-E or the protected aquifer) at the North St. Louis County sites were re-evaluated to fully consider additional available data. HZ-C is gravelly in mapped and screened contiguous locations in North St. Louis County. HZ-C overlies the jointed HZ-E bedrock, so that the HZ-C water represents the water quality of the HZ-E, whose water is difficult to extract. Thus, HZ-C is a surrogate for HZ-E. Additional monitoring wells and proper sampling protocols for all wells provided adequate basis for evaluation of the HZ-C/HZ-E water's background. The background was detailed and specified in the Environmental Monitoring Data and Analysis Report for CY 2002. As such, the background values were revised based on additional available data. The comparison values for North St. Louis County sites ground-water data will be revised when a final ROD is issued for the North St. Louis County sites. Ground-water data from HU-B at the SLDS are compared to the ILs established in the SLDS ROD (USACE 1998c) and to MCLs if an IL was not established. Prior to August 2003, both filtered and unfiltered samples were collected from St. Louis Sites ground-water wells. Currently, only unfiltered samples are collected.

The following table summarizes those background values that have changed.

Table VI-4. Revised Background Values for the North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones

Chemical	Background	Revised Background	Units
Antimony		4	µg/L
Arsenic	82.7	180	µg/L
Barium	424	1,400	µg/L
Cadmium		2	µg/L
Chromium		13	µg/L
Molybdenum	0	68	µg/L
Nickel	1.1	18	µg/L
Radium-226	1.03	4	pCi/L
Radium-228		NR	pCi/L
Selenium		2	µg/L

Table VI-4. Revised Background Values for the North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones (Cont'd)

Chemical	Background	Revised Background	Units
Thallium	0	7	µg/L
Thorium-228	0.62	2	pCi/L
Thorium-230	0.63	4	pCi/L
Thorium-232		2	pCi/L
Total Uranium		7	pCi/L
Uranium-234	0	~4	pCi/L
Uranium-235		NR	pCi/L
Uranium-238	0.11	~3	pCi/L
Vanadium		18	µg/L

NR = Not Reported – no detectable samples for that analyte

For those wells where sufficient data were available to evaluate a trend, the unfiltered ground-water data were evaluated using Mann-Kendall statistical testing. The Mann-Kendall trend analysis was performed at a 95% level of confidence. The complete results of the testing for the SLS are presented in EMDAR CY2002 (USACE 2003e). Statistically significant trends do not always reflect actual trends. The Mann-Kendall test does not consider the effects of measurement error and does not provide any information concerning the magnitude of the trends, so time-concentration plots were used to evaluate these factors.

HISS

Stratigraphy

The stratigraphy beneath the HISS is similar to that found at the SLAPS, with the exception that the shale unit (HZ-D) is absent at the HISS. Four HZs (HZ-A through HZ-C and HZ-E) are present at the HISS. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C and HZ-E are referred to as the lower zone. With the exception of monitoring wells HISS-5D and HW23, which are screened in the HZ-C, all of the monitoring wells at the HISS are screened in the HZ-A. HW22 and HW23 are upgradient wells installed to assist in evaluating background conditions.

Sampling Program

Sampling was conducted at 17 ground-water monitoring wells in CY1998. Arsenic, cadmium, manganese, selenium, total U, and trichloroethene (TCE) were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples. Although manganese and TCE were detected in HZ-A, they have been determined in the North St. Louis County sites FS not to be MED/AEC COCs. It should be noted that USACE screens for TCE and manganese as well as other metals to confirm that excavation water is properly treated and meets release requirements.

During CY1999, 15 ground-water monitoring wells were sampled at the HISS. Arsenic, cadmium, manganese, selenium, total U, and TCE were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples.

Three monitoring wells (HW23, HW24, and HW25) were installed during CY2000. Therefore, 18 ground-water monitoring wells were sampled at the HISS for this calendar year. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-dichloroethene (DCE) were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Th-230 was detected in HZ-A ground-water samples above its background value. No exceedences were noted in the HZ-C well samples.

Sampling was also conducted at 18 ground-water monitoring wells at the HISS during CY2001. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-DCE were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Constituents exceeding their respective MCLs or SMCLs in samples collected from the two HZ-C wells included arsenic, manganese, and thallium. The maximum concentrations of arsenic also exceeded its expected background level.

During CY2002, 15 ground-water monitoring wells were sampled at the HISS. The locations of the ground-water monitoring wells are shown on Figure VI-1. The CY2002 data indicated localized effects on the HZ-A ground water from site-related constituents. Arsenic, manganese, selenium, Ra-226, and TCE were detected above their respective MCLs or SMCLs in samples from one or more HZ-A wells. The sampling results for HZ-C ground water indicate that arsenic and manganese had average concentrations that exceeded their respective MCLs or expected background concentrations for the HZ-C ground water.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of arsenic, selenium, total uranium, and Th-230 are increasing or decreasing over time in samples from HZ-A wells. The test was performed on eight HZ-A wells (HISS-01, HISS-06, HISS-07, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW21) that have yielded samples with selenium concentrations above its corresponding MCL at least once in the period from the winter of CY1997 through winter CY2002. Based on the trend analysis, a decreasing trend in selenium concentrations was observed at HISS-20S, primarily due to elevated concentrations of selenium during the 1999 sampling event. Samples from HISS-14 located near the eastern edge of the site exhibited increasing selenium concentrations. The cause of the increasing selenium concentrations is not known, but the increase appears to be of small magnitude, based on the time-concentration plot shown in Figure VI-2. The best fit trend lines for the selenium time-concentration plots are shown as dashed lines in Figure VI-2. Samples from the five remaining wells exhibited no concentration trends for selenium.

Arsenic has been detected at elevated levels in only a single well, HISS-19S. The concentrations of arsenic in samples from Well HISS-19S appear to be increasing over time based on the results of the Mann-Kendall test and the time-concentration plot shown in Figure VI-2. The cause of the increasing arsenic concentrations in this well is not known.

The Mann-Kendall trend analysis was conducted for total uranium on ground-water samples collected from HZ-A Wells HISS-01, HISS-06 and HW21. The complete analysis is presented in the EMDAR CY2002 (USACE 2003e). Samples from these wells have yielded total uranium concentrations above its corresponding MCL. The trend analysis was also conducted on seven wells (HISS-07, HISS-10, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW22) that yielded samples with total uranium concentrations less than its corresponding MCL but with a greater than 80 percent detection rate and at least seven rounds of data. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for two HZ-A wells, HISS-01 and HISS-07. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for HISS-01 and HISS-07. However, this statistical test does not take into account the range of error inherent in the analytical measurements (the error bars are shown in Figure VI-2 are bracketed vertical lines). When the potential error in the measurement is taken into account, the ranges associated with the total uranium values in HISS-01 and HISS-07 are generally wider than the magnitude of the trend. This indidcates that the determination of an overall trend is inconclusive. A “no trend” line for these two wells is shown as a horizontal dashed line on the total uranium graphs in Figure VI-2. Due to the high percentage of non-detect (ND) values (greater than 20 percent ND), the Mann-Kendall trend analysis could only be performed on Th-230 for samples from wells HISS-10 and HISS-11. The results of the trend analysis indicated no statistically significant trends in Th-230 concentrations.

The Mann-Kendall trend analysis was conducted for HZ-C Wells HISS-05D and HW23 for the following constituents: arsenic, iron, and manganese. The results of the analysis indicate that there is a downward trend in manganese concentrations in HISS-05D.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the HISS are shown in Figure VI-2.

SLAPS and SLAPS VPs

Stratigraphy

There are five HZs recognized beneath the SLAPS and its adjacent VPs. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; HZ-D, comprising the Interbedded Pennsylvanian rock and shale; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C, HZ-D, and HZ-E are referred to as the lower zone. Although the ground-water monitoring well network extends beyond the borders of the SLAPS to its associated VPs, the network is referred to as the SLAPS monitoring well network.

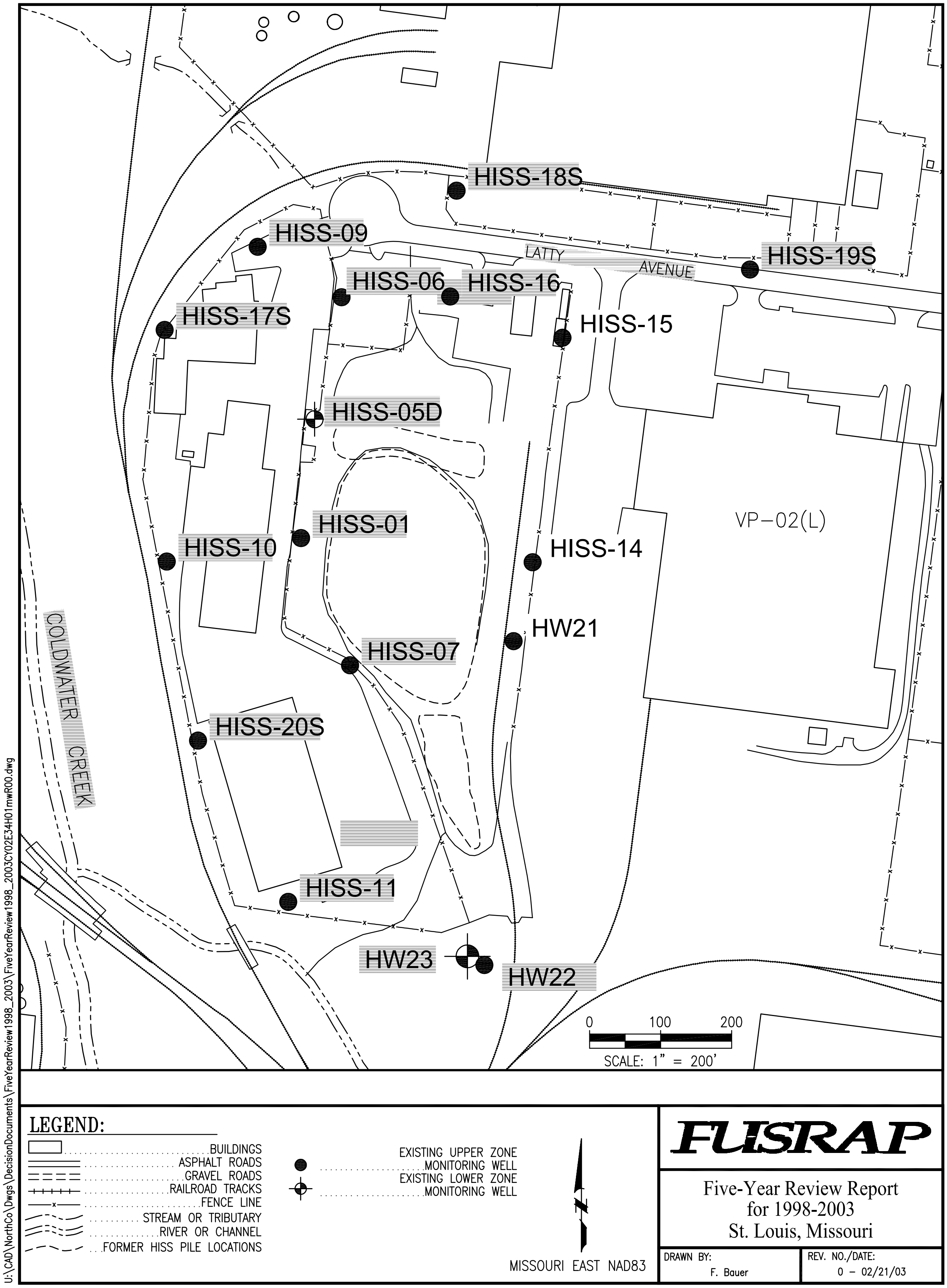
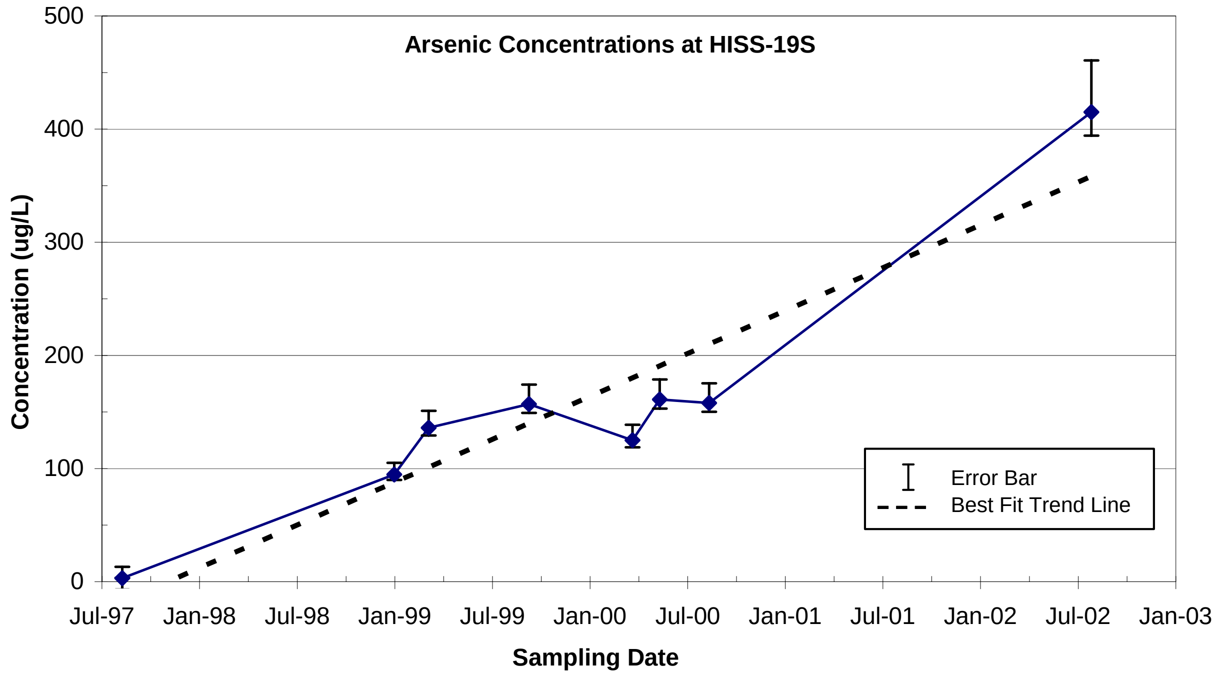
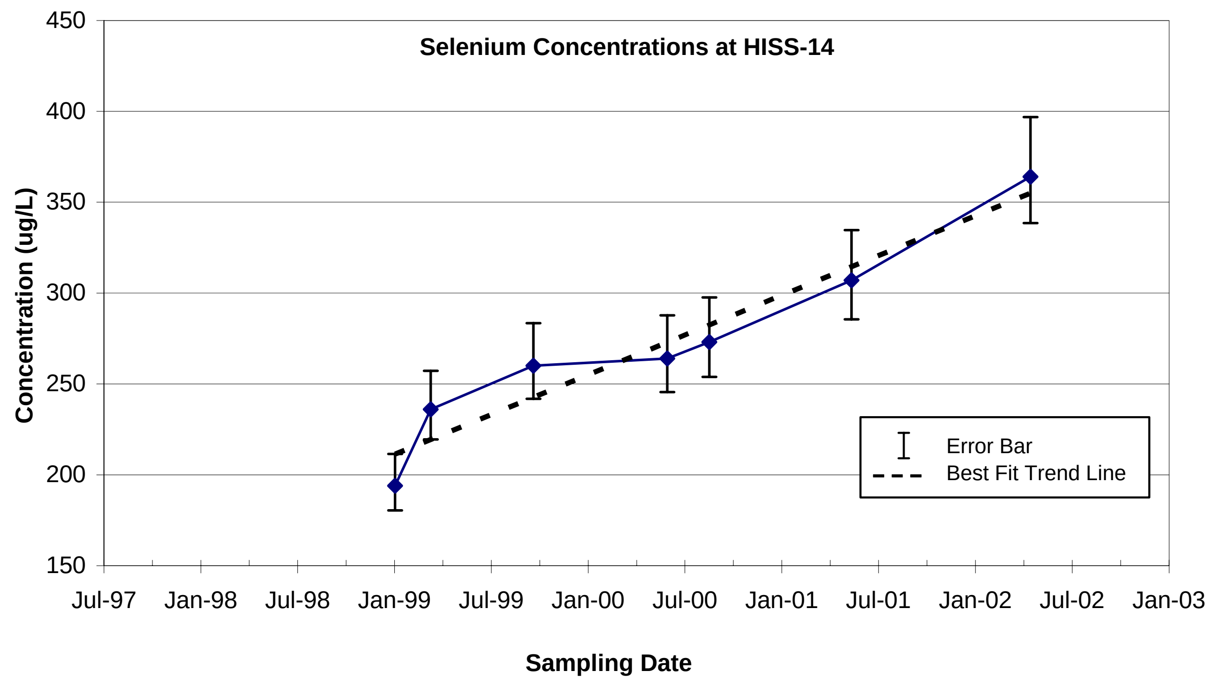


Figure VI-1. Ground-water Monitoring Well Locations at the HISS in CY 2002

Figure VI-2. Trend Analysis at the HISS



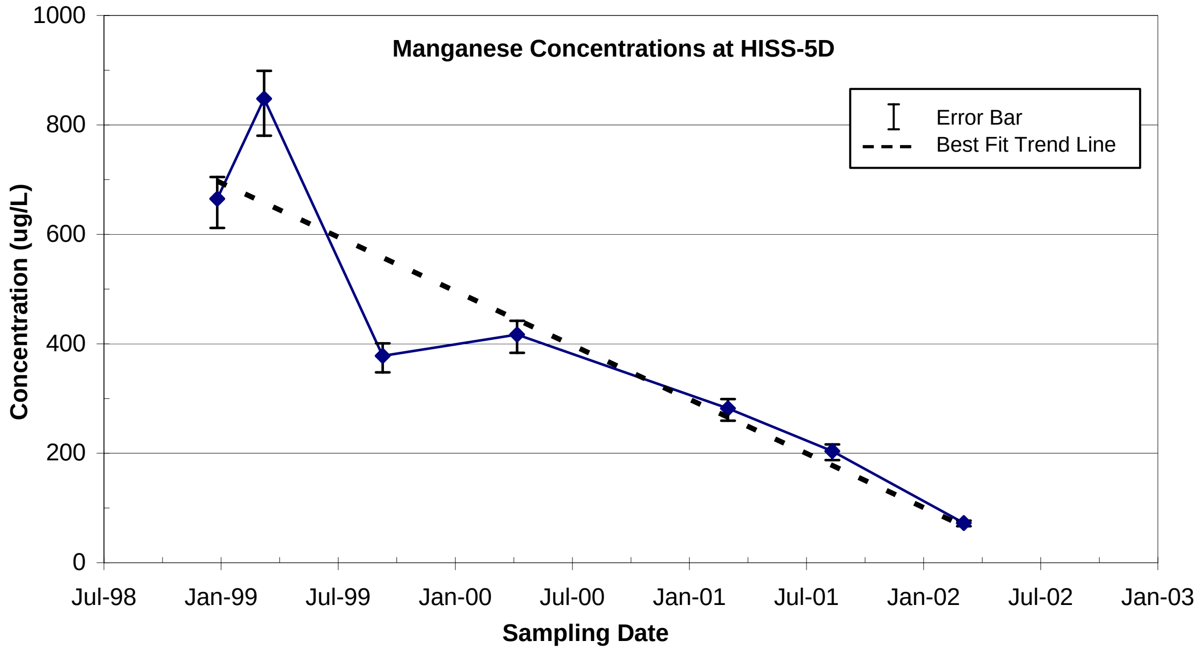


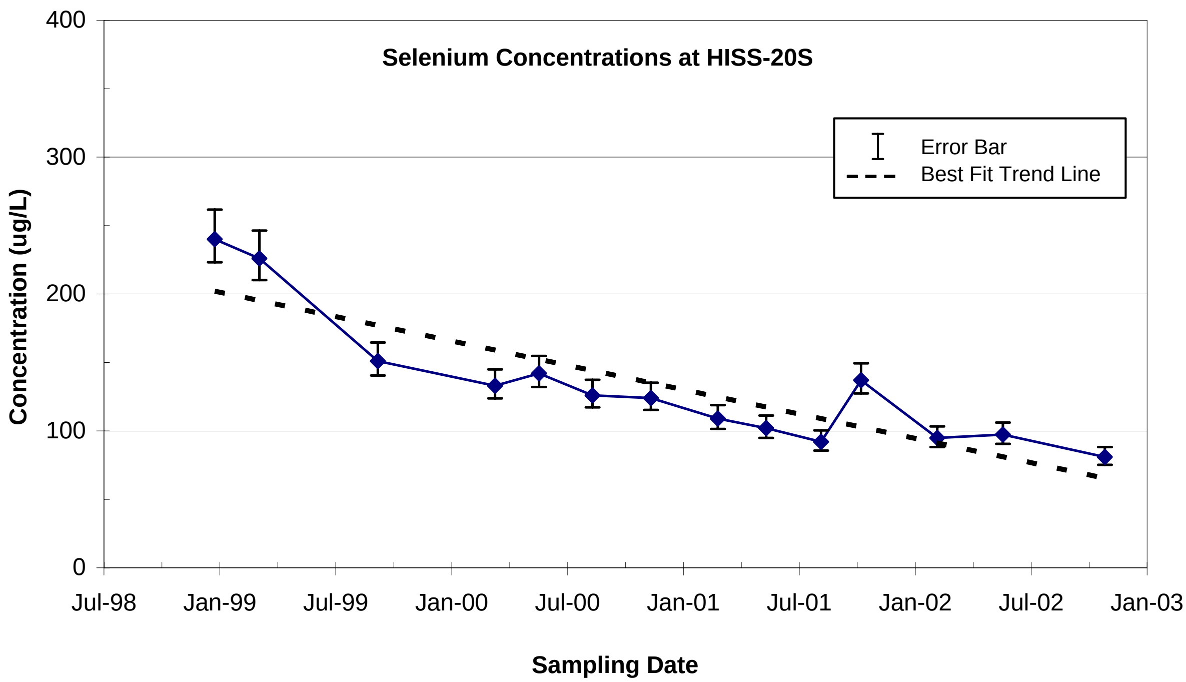
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)



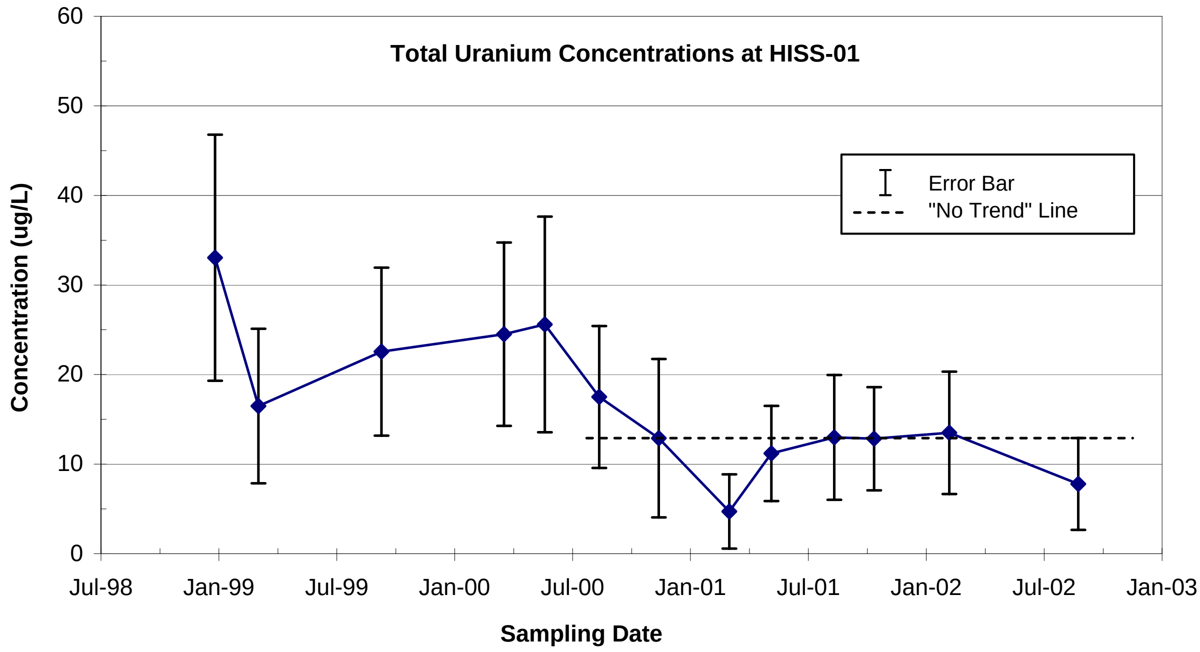


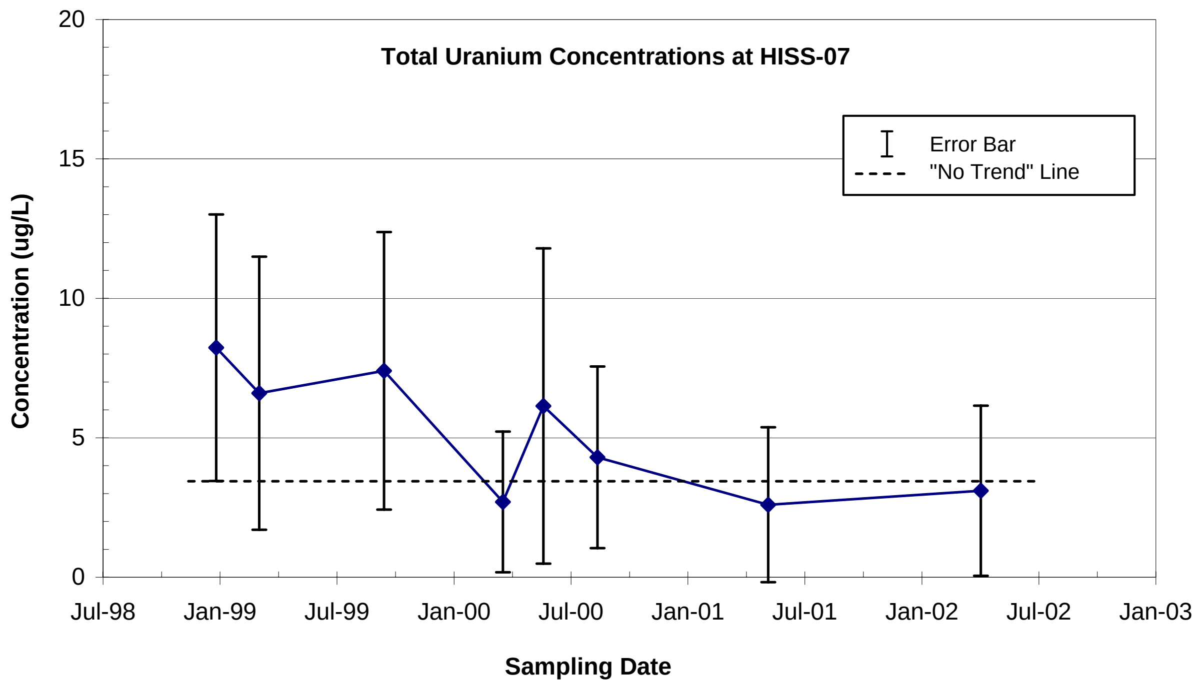
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)





Notes:
The error bar represents ± the sum of the measurement error for U-234, U-235, and U-238.

Sampling Program

In CY1998, the SLAPS monitoring well network consisted of 38 ground-water monitoring wells. Four monitoring wells were installed in CY1998 to fill data gaps pertaining to subsurface lithology, hydraulic gradient, and ground-water quality issues. Seven monitoring wells were concurrently abandoned due to their proximity to removal actions being conducted on the SLAPS proper. Twenty-eight wells were sampled in July and August of 1998, and 38 wells were sampled in the fourth quarter of 1998. Arsenic was detected above its corresponding MCL in several upper and lower zone well samples. Total uranium, selenium, and TCE were detected above their respective MCLs in several upper zone well samples.

The network consisted of 41 wells, but only 38 were sampled in CY1999. Five HZ-A wells yielded total uranium concentrations above the corresponding MCL in CY1999. Selenium and TCE were detected above their respective MCLs in the upper zone. Arsenic was present in lower zone samples above its corresponding MCL.

Forty-six ground-water wells were sampled in CY2000 at the SLAPS. Five of these wells (PW39 through PW43) were installed during CY2000, with sampling initiated in the third quarter of the calendar year. These wells were placed in areas where ground-water information was needed to provide insight into contaminant migration and surface water effects. Results of the ground-water sampling conducted during CY2000 indicate that metal, radionuclide, and organic constituents were present above MCLs or SMCLs in HZ-A ground-water samples collected at the SLAPS. These constituents included the metals arsenic, chromium, iron, manganese, nitrate,selenium, and thallium; the radionuclides Ra-226 and total uranium; and the organics 1,2-DCE and TCE. Additional radionuclides, in particular Th-230, U-234, U-235, and U-238, were detected in HZ-A ground water but have no designated MCLs or SMCLs. Arsenic, iron, and manganese were present above MCLs or SMCLs in ground-water samples from the lower zone. In addition, Ra-226 for CY2000 was detected at levels slightly exceeding the MCL in samples from four wells screened in HZ-C. None of these wells are on the SLAPS.

Forty-six ground-water wells were sampled in CY2001 at the SLAPS. Metal (arsenic, chromium, iron, manganese, nitrate, selenium, and thallium), radionuclide (Ra-226, Th-230, U-234, and U-238), and organic (TCE and 1,2-DCE) constituents were detected above MCLs, SMCLs, and/or background values in HZ-A ground-water samples. Arsenic, iron, and manganese were also present above MCLs or SMCLs in samples from the lower zone. In CY2001, total uranium and Ra-226 were not detected above their respective MCLs in samples from any wells screened exclusively across the lower zone. Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels.

Forty-six ground-water wells were also sampled in CY2002 at the SLAPS. The locations of the ground-water monitoring wells at the SLAPS are shown on Figure VI-3. The CY02 sampling results indicate that various metals, radionuclides, and organic compounds are present at elevated levels in HZ-A ground water at the SLAPS. Based on the CY2002 data, the principal inorganic contaminants in shallow HZ-A ground water at the site include arsenic, chromium, iron, manganese, nitrate, selenium, and thallium, which were detected above their respective MCLs, SMCLs, and/or background values in HZ-A ground-water samples. The radionuclides Ra-226, Th-230, U-234, and U-238 were also detected above their respective MCLs, SMCLs and/or background values in HZ-A ground-water samples. Additionally, the organic constituents TCE and 1,2-DCE were detected at concentrations above their respective MCLs in several shallow zone wells. Arsenic, iron, and manganese were present above their respective MCLs or SMCLs in samples from the lower zone. Total uranium was not detected in CY2002 above its MCL in any wells screened exclusively across the lower zone. Ra-226, Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels. The CY2002 data continue to support the determination that HZ-B, Subunit 3M, a relatively impermeable clay layer, is preventing the migration of constituents to lower ground-water zones. The localized constituent concentrations present in HZ-A ground water are not present in the deeper zones, indicating that mixing between HZ-A and HZ-C, HZ-D, and HZ-E ground-water zones is insignificant. In CY2003, two wells were installed in remediated areas of the SLAPS to verify the effectiveness of source removal. The results of sampling in these wells will be discussed in the next five-year review.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to assess whether concentrations of arsenic, selenium, and total uranium are increasing (upward trending) or decreasing (downward trending) over time. The Mann-Kendall test does not consider the effects of measurement error, so time-concentration plots were used to evaluate the validity of the Mann-Kendall results. Because concentrations have been consistently low and the incidence of non-detection consistently high, a trend analysis was not performed for Ra-226 or Th-230. Although no organics were identified as COCs for the SLAPS, a statistical analysis was conducted for TCE because elevated concentrations have been consistently detected in several HZ-A wells.

A Mann-Kendall trend analysis was conducted for two HZ-A wells (B53W14S and M10-08S) and 15 HZ-C wells yielding samples showing arsenic concentrations consistently exceeding the MCL since July 1997. The Mann-Kendall results indicate that four HZ-C wells (B53W01D, M10-15D, PW36, and PW42) have statistically increasing trends. However, this statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is taken into account, the errors associated with the arsenic values in B53W01D are generally wider than the magnitude of the trend (Figure VI-4). This indicates that the determination of an overall trend for this well is inconclusive. Two HZ-C wells (B53W12D and MW34-98) have decreasing trends based on the results of the Mann-Kendall test. This statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is considered, the ranges associated with the arsenic values in B53WI2D are generally wider than the magnitude of the trend (see Figure VI-4). This indicates that the determination of the overall trend is inconclusive. For the remaining HZ-C wells, no trend in arsenic concentrations was observed. The lack of a correlation between the arsenic concentrations in the HZ-C ground-water samples and those reported for nearby HZ-A well samples indicates that the increasing arsenic trend in one HZ-C monitoring well on SLAPS cannot be related to FUSRAP-related activities at the SLAPS.

There are several wells screened in HZ-A that have consistently yielded samples from July 1997 through CY2002 with selenium levels above its MCL. A Mann-Kendall trend analysis was performed on the following eight HZ-A wells: B53W09S, B53W13S, B53W17S, M10-15S, MW31-98, MW33-98. PW38, and PW39. Two wells (M10-15S and PW41) showed increasing trends based on the Mann-Kendall test. The Mann-Kendall test does take into consideration the range of error inherent in analytical measurements. When the potential errors in the measurements are taken into account as shown in the time-concentration plots in Figure VI-5, the

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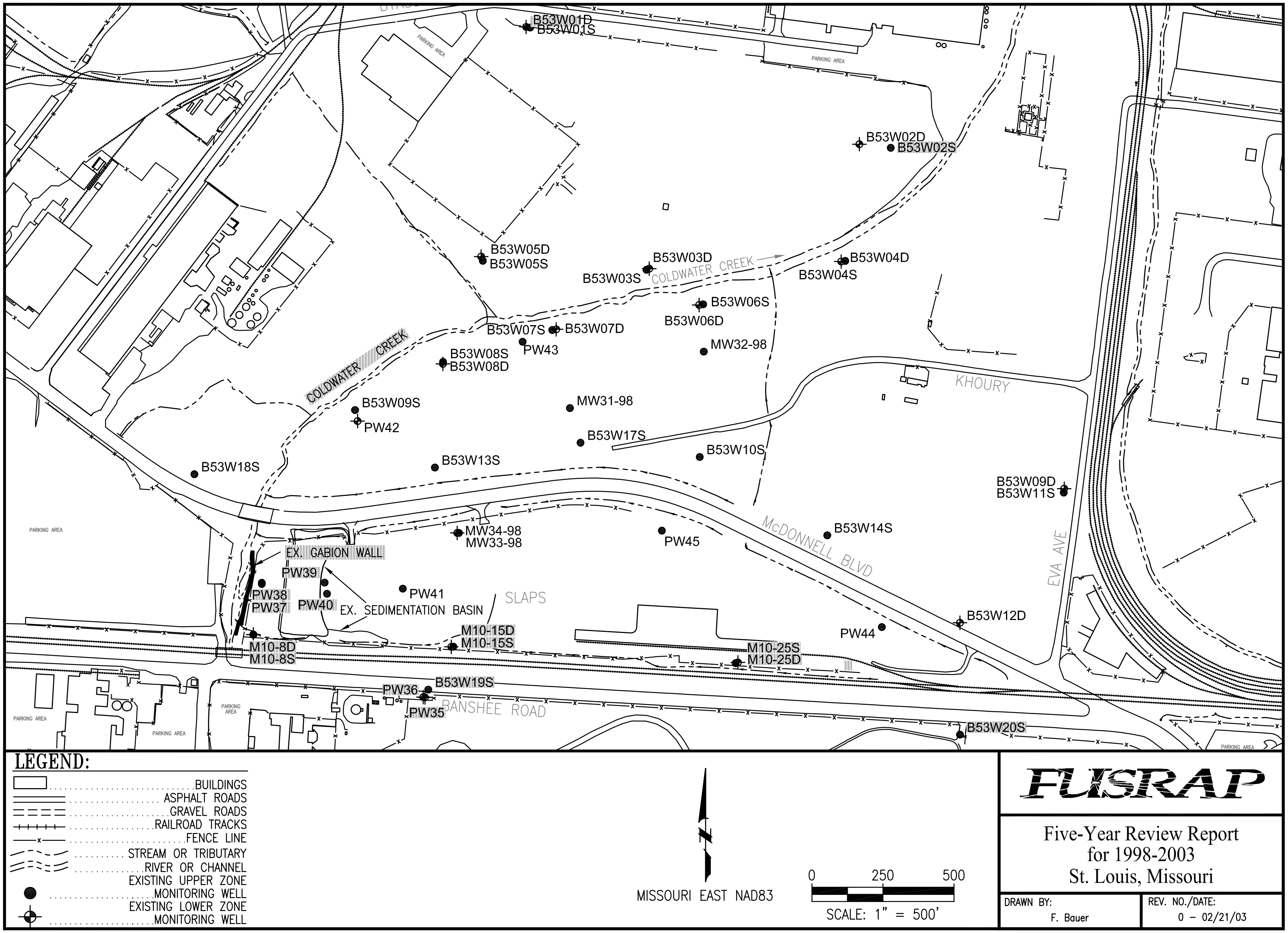


Figure VI-3. Ground-water Monitoring Well Locations at the SLAPS in CY 2002 ranges associated with the selenium values for PW41 and M10-15S show a no trend line which generally falls within the error bars. This indicates that an overall trend for these wells is inconclusive. If there is an increasing trend in these two wells, it may reflect a short-term increase resulting from removal activities being conducted at the SLAPS in the vicinity of the wells. However, continued monitoring will be necessary to determine the cause. Four wells showed decreasing selenium trends (B53W13S, B53W17S, MW33-98, and PW38) based on the Mann-Kendall test. The error measurements associated with the MW33-98 selenium values indicate there is no trend for the sampling data collected since August 2000.

Total uranium concentrations in samples from 16 HZ-A wells were subjected to the Mann-Kendall trend analysis. The analysis was performed on data collected from the fall of CY1998 through CY2002. An increasing trend was observed in two wells (MW33-98 and PW39). The Mann-Kendall statistical test does not take in to account the range of error inherent in the anaylitical measurements. The determination of an overall trend for PW39 is inconclusive, since the error associated with total uranium values is generally wider than the magnitude of the trend (see Figure VI-6). The remaining 14 wells displayed no trend. The increasing concentrations of total uranium in MW33-98, located adjacent to the Radium Pits area, may be related to removal activities that were being conducted in areas located immediately upgradient of the well. Total uranium concentrations remain at non-detect levels in MW34-98, located adjacent to MW33-98, indicating that HZ-C is not being impacted.

A Mann-Kendall trend analysis was performed for TCE on eight wells (B53W13S, B53W17S, MW31-98, MW33-98, PW38, PW39, PW40, and PW41). The results of the analysis indicate that one well (B53W13S) is showing an increasing trend in concentrations and one well (B53W17S) is showing a decreasing trend. As shown in Figure VI-7, the magnitude of the decreasing TCE trend for B53W17S is generally within the limits of the measurement error, indicating that the determination of an overall trend for this well is inconclusive. The magnitude of the increasing TCE trend for B53W13S is very small (i.e., an increase from 4 ug/L to 12 ug/L over the five-year period from July 1997 to September 2002). The sampling results may indicate that TCE is present due to a discrete release of TCE in the vicinity of B53W17S in the past. In addition to TCE, the TCE degradation product 1,2-DCE has been detected in the area. These detections suggest that some degradation of TCE is occurring in this area. The gradually increasing concentrations in downgradient well B53W13S may indicate that TCE is continuing to migrate slowly westward from the source area.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLAPS are shown in Figures VI-4 through VI-7.

SLDS

Stratigraphy

Ground water at the SLDS is found within three HUs. These HUs are the upper, HU-A unit, which consists of fill overlying clay and silt; the lower, Mississippi Alluvial Aquifer, referred to as HU-B; and the limestone bedrock, referred to as HU-C.

Sampling Program

The SLDS ROD (USACE 1998c) requires the implementation of a long-term ground-water monitoring program at the site. The selected remedy includes the installation and monitoring of perimeter ground-water monitoring wells on a long-term basis. The goal of the ground-water monitoring program is to monitor the protection of the potentially usable HU-B ground water and establish the effectiveness of the source removal action.

Regular monitoring of the SLDS HU-A and HU-B ground water was initiated in late CY1998 pursuant to issuance of the SLDS ROD (USACE 1998c). A baseline-sampling event had been conducted previously, in December 1997 and January 1998. Fifteen wells were sampled for radiological, metal, and organic parameters in late CY1998. Arsenic, magnesium, selenium, and total uranium were detected in HU-A ground-water samples above their respective regulatory-based values. No ILs or MCLs were exceeded in HU-B well samples.

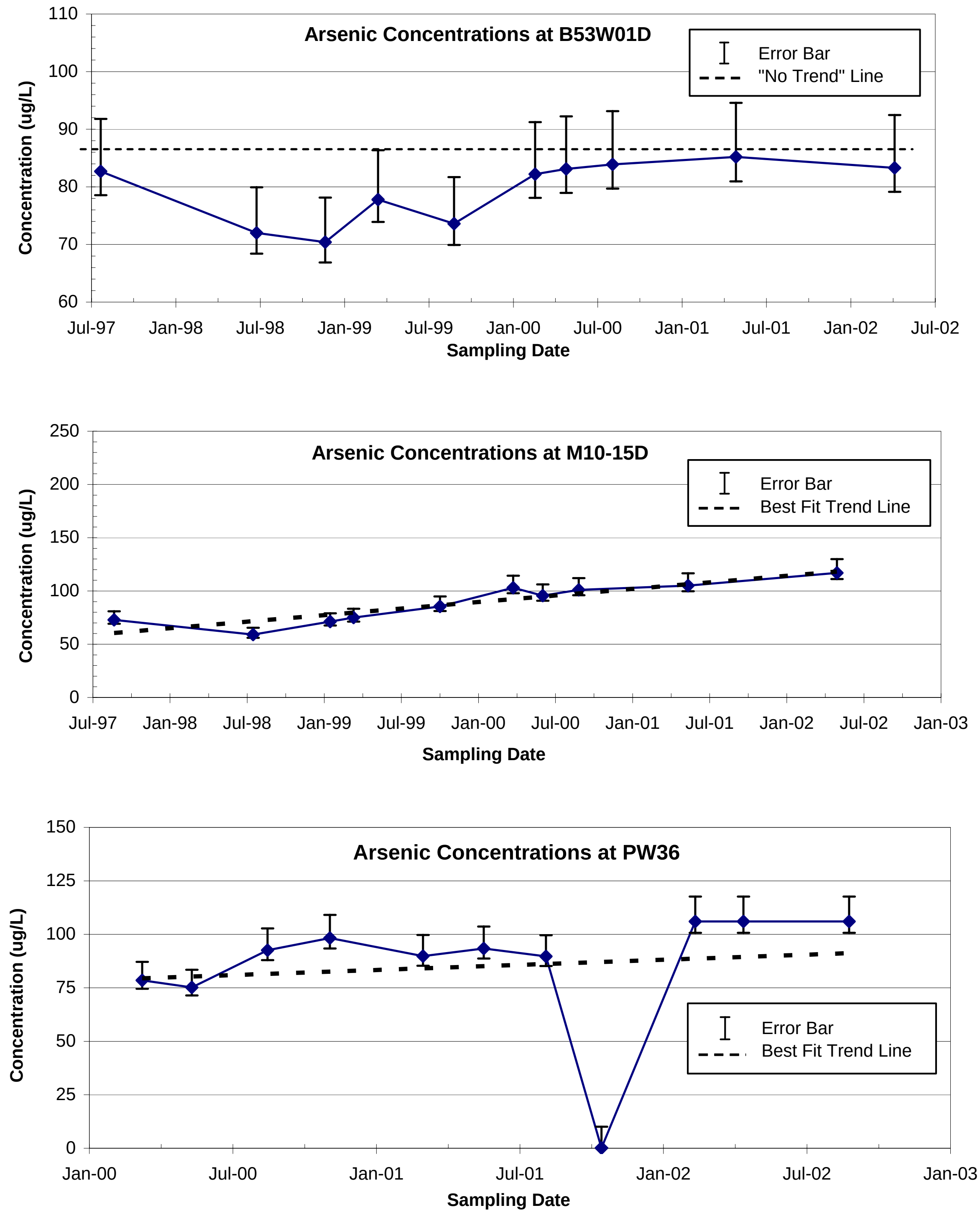
Eight new ground-water monitoring wells were installed prior to CY1999. These wells were identified as DW14, DW15, DW16, DW17, DW18, DW19, DW20, and DW21. Thus, 23 wells were sampled in CY1999. Ground-water samples from four HU-A wells and one HU-B well (DW19) exhibited total uranium concentrations above the MCL and IL of 20 µg/L, respectively. Ground-water samples from several HU-A and HU-B wells exhibited arsenic concentrations above its IL and the MCL. The only exceedence of the cadmium MCL was the HU-A Well B16W10S. Ra-226 exceeded its corresponding MCL in only one sample from one HU-A well, DW20. Samples from 22 of the 23 wells were collected in CY2000. Well DW20 was not sampled because the well rarely contained appreciable amounts of water. Ground-water samples from at least one HU-A and HU-B well exhibited arsenic and total uranium concentrations above their respective IL and MCL. Ra-226 concentrations exceeded its corresponding MCL in one HU-A well and one HU-B well.

One new ground-water monitoring well, DW22R, was installed at the SLDS in CY2001. This well is located on DT-8 and is intended to serve as an upgradient monitoring well for HU-B ground water at the SLDS. Data from this well will be used to determine background concentrations for the COCs in the HU-B ground water. Twenty-three wells were sampled in CY2001, including well DW22R. Well DW20 was not sampled in CY2001. Arsenic and total uranium exceeded their respective IL in more than one HU-A ground-water sample and more than one HU-B ground-water sample during CY2001. Ra-226 was detected only once above its MCL in one HU-A ground-water sample and more than once above its MCL in HU-B ground-water samples. Cadmium was detected only once above its IL in one HU-A well ground-water sample. Because significant exceedences of the ILs for arsenic and total uranium had been observed in the HU-B ground-water samples, the GRAAA was initiated in CY2001. Phase I of the GRAAA, the assessment phase, was completed in CY2002. Results of the Phase I indicate there is a need to conduct Phase II, the investigative phase.

Ground-water monitoring well DW20 was transferred to Mallinckrodt in the fourth quarter of CY2001 and is no longer included in the monitoring well network for the SLDS. Four monitoring wells (B16W05S, B16W05D, B16W11S, and DW22) were decommissioned in late CY2001.

The locations of the ground-water monitoring wells at the SLDS are shown in Figure IV-8. The CY2002 ground-water monitoring results indicated that ILs for arsenic and total uranium continued to be exceeded in both HU-A and HU-B ground-water samples. Monitoring wells DW14 and DW15 exceeded the IL for arsenic. Significant exceedance of the total uranium IL in DW19 occurred. Ra-226 was generally detected at low frequencies in both HU-A and HU-B ground-water samples. Cadmium was not detected in any samples from HU-A or HU-B wells.

Figure VI-4. Trend Analysis at the SLAPS - Arsenic

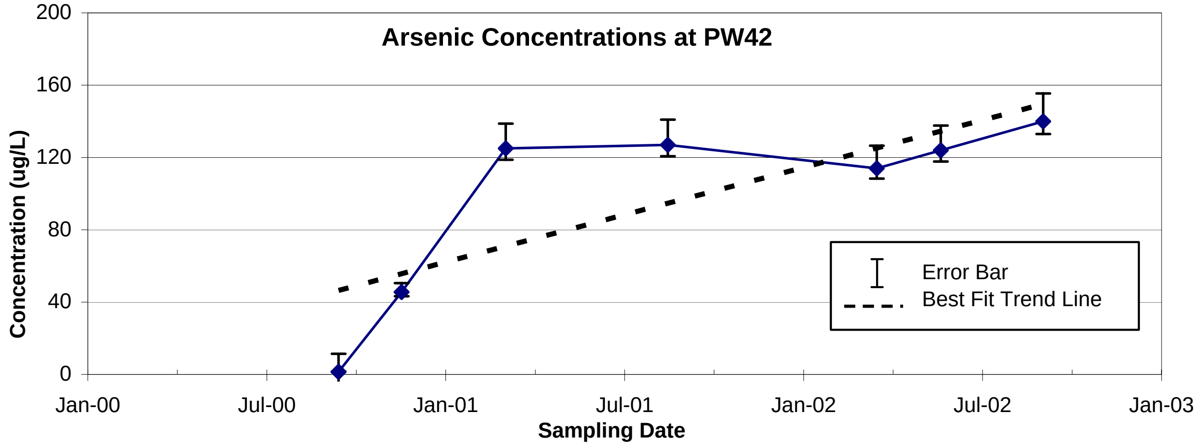


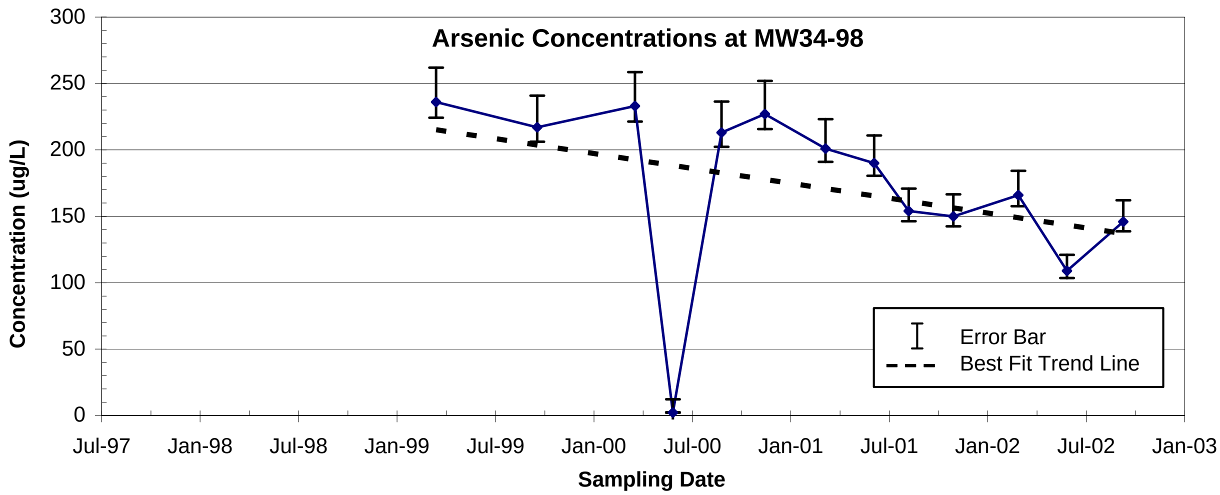
Notes:

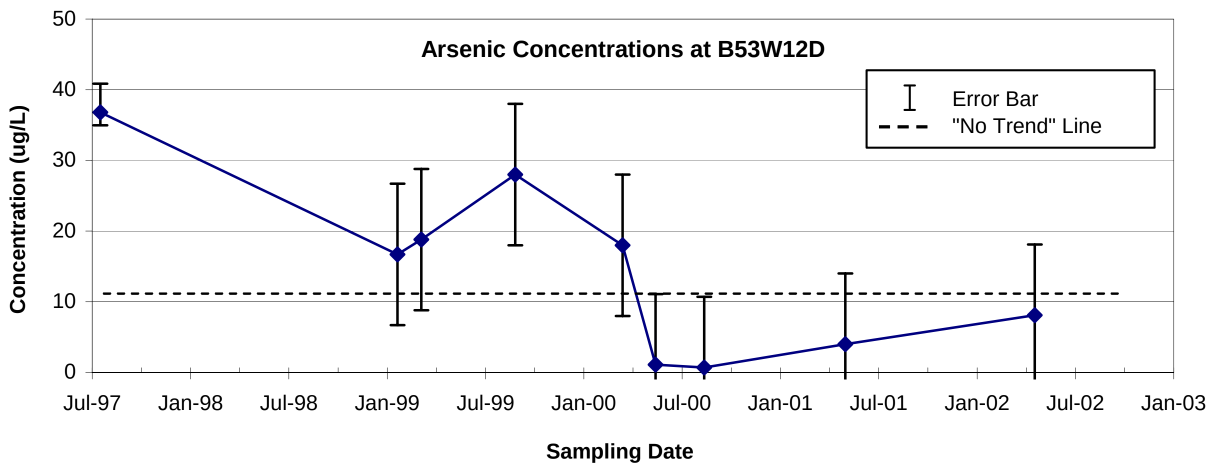
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-4. Trend Analysis at the SLAPS - Arsenic (Continued)





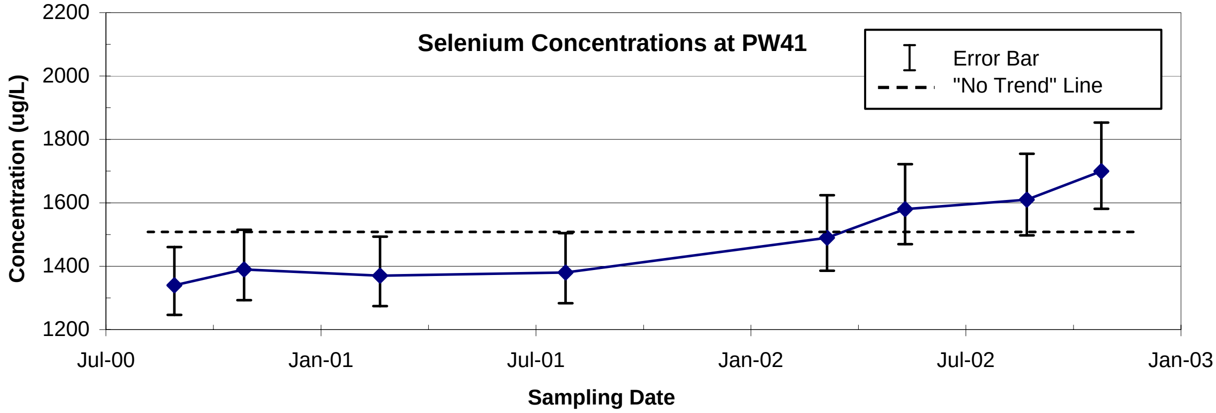


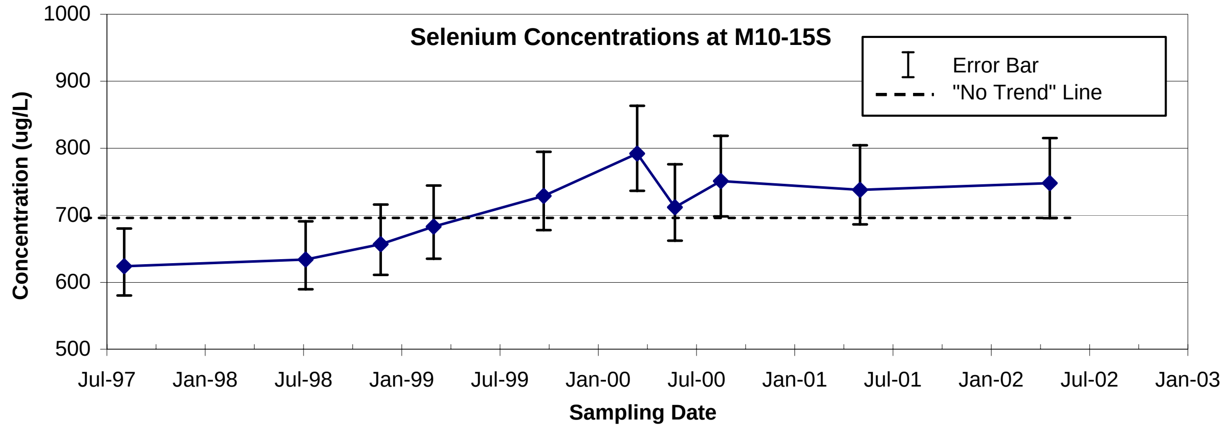
Notes:

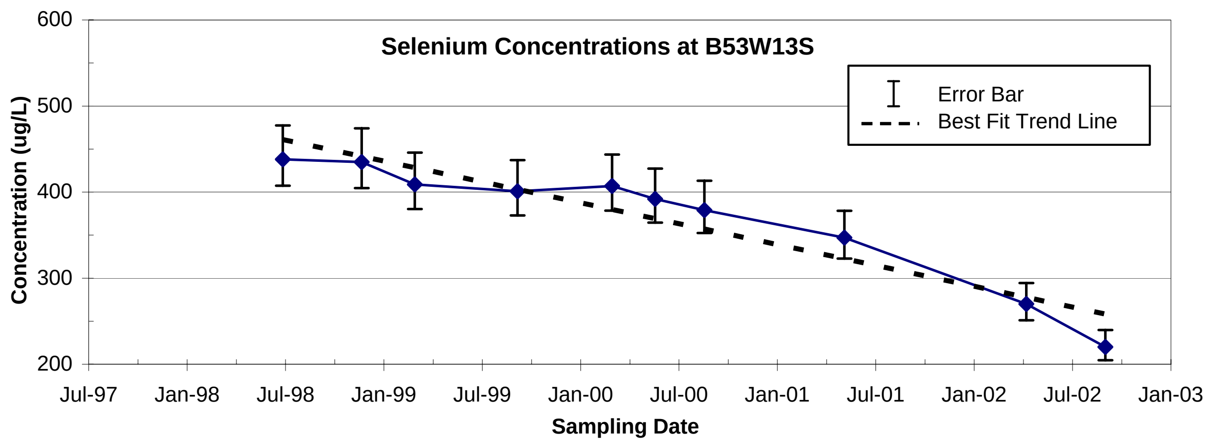
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium





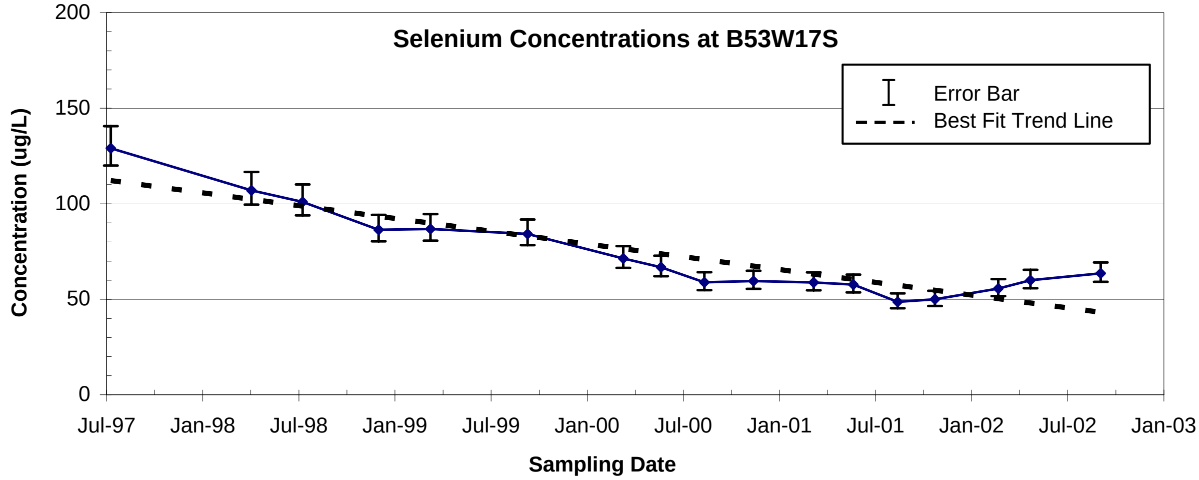


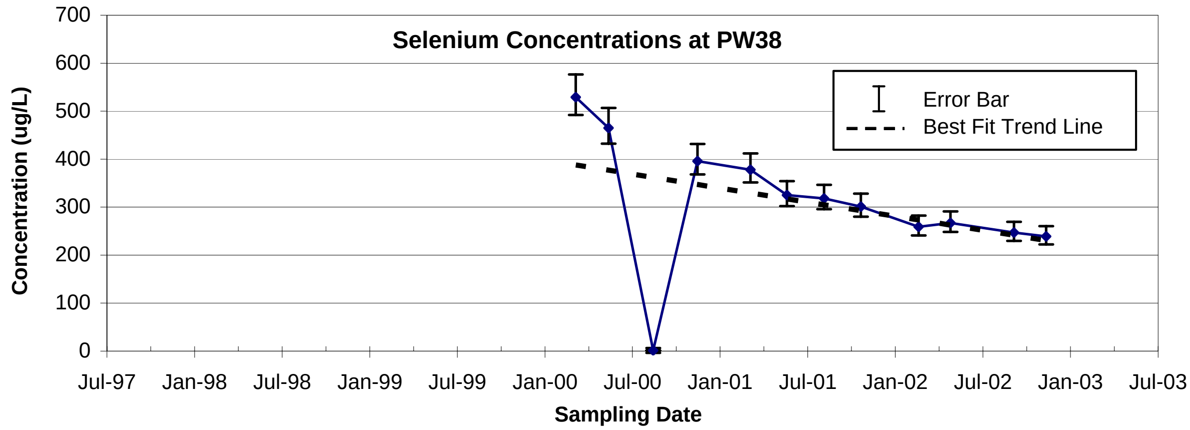
Notes:

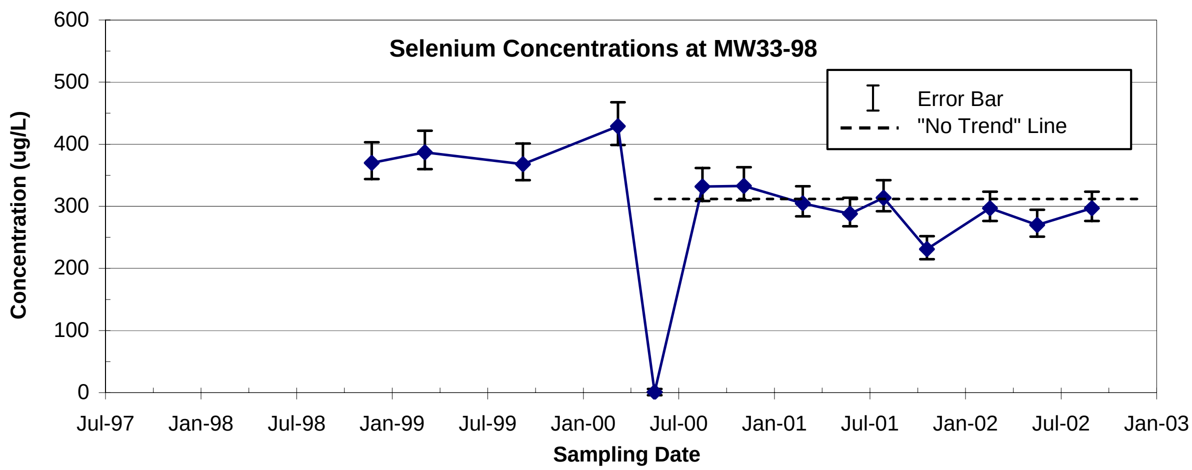
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium (Continued)





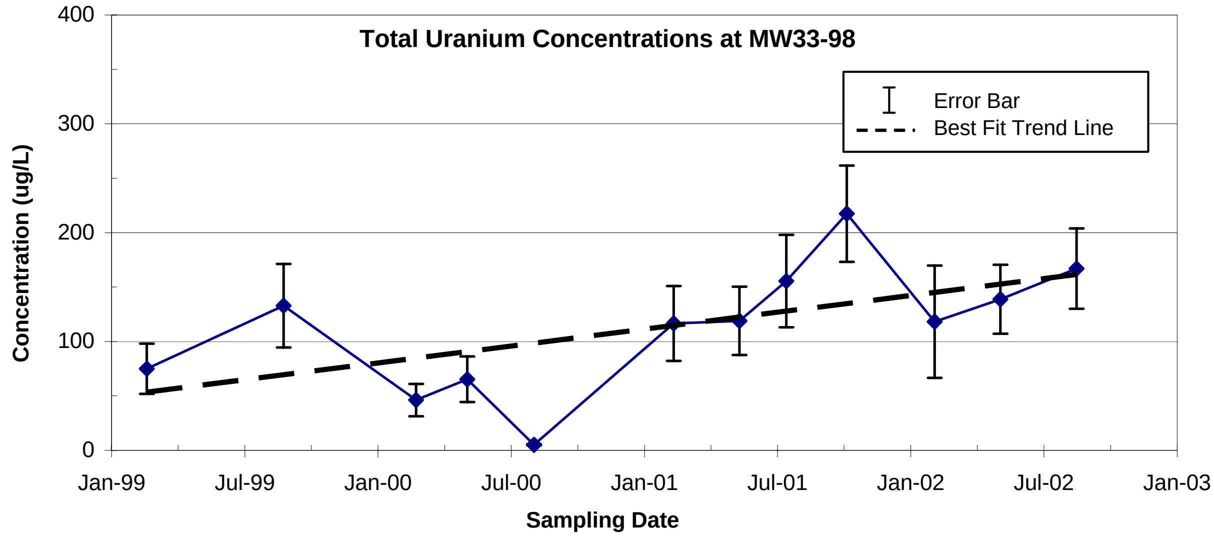


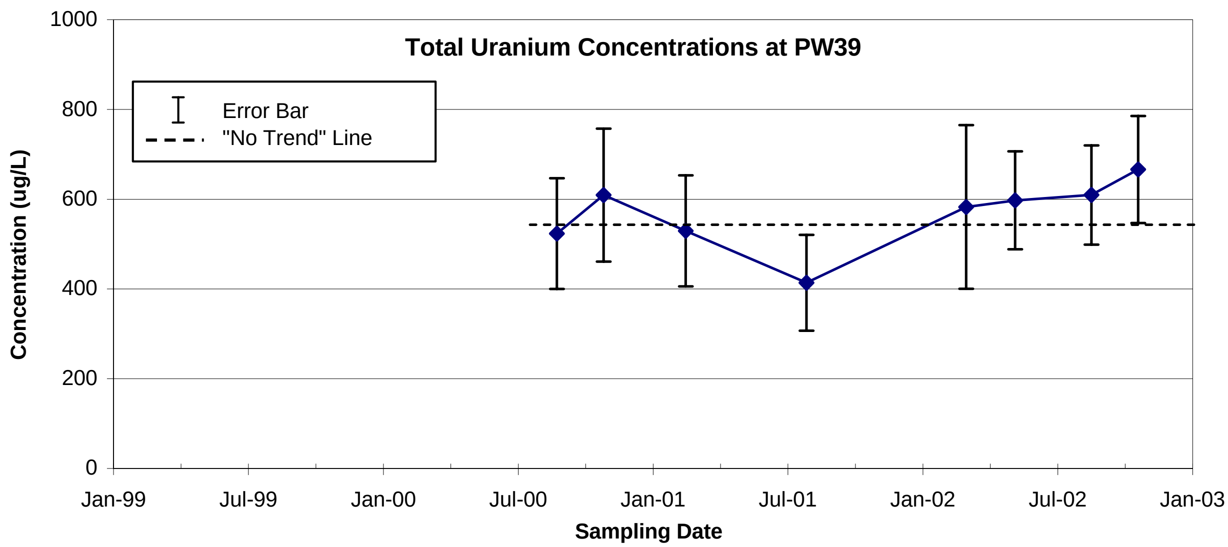
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-6. Trend Analysis at the SLAPS - Total Uranium

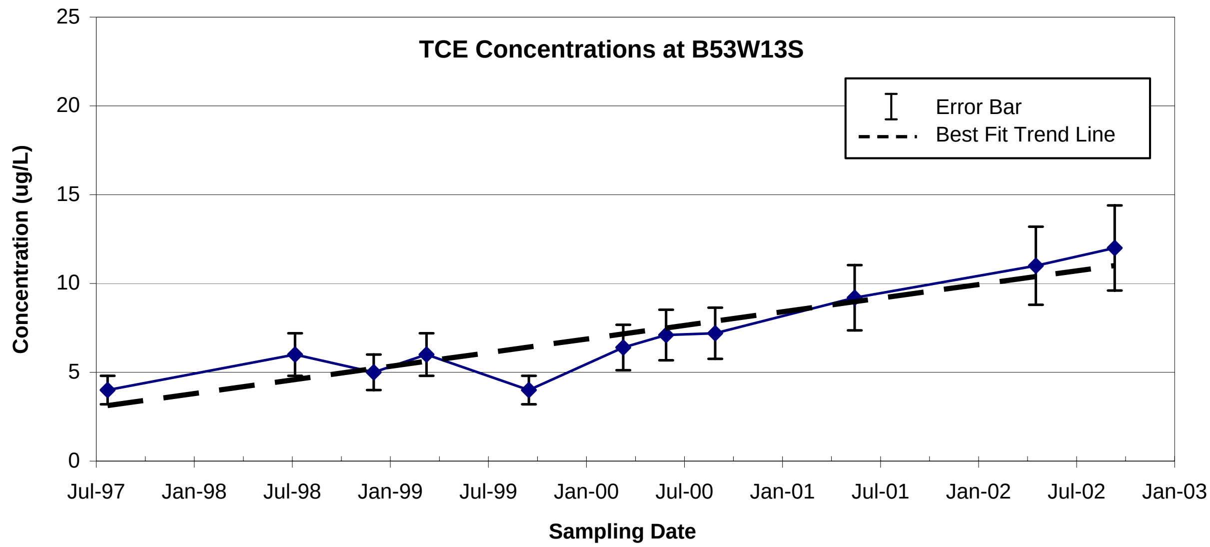


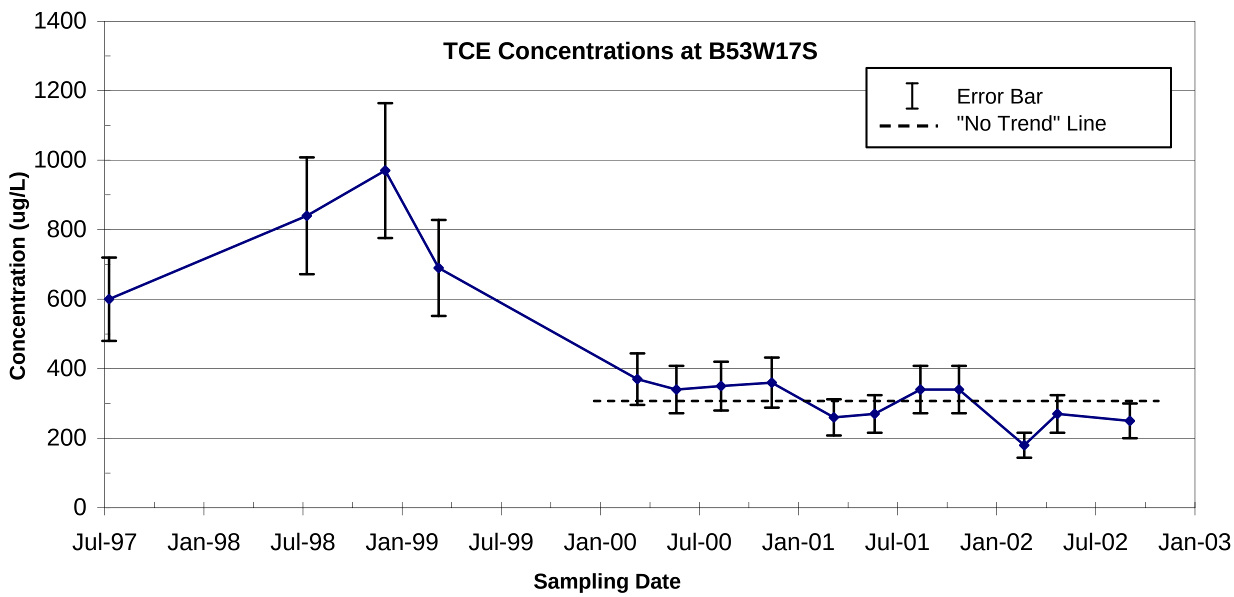


Notes:

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-7. Trend Analysis at the SLAPS - Trichloroethene





Notes:

For TCE, the measurement error was assumed to be ±20%

Trend Analysis

A quantitative evaluation of arsenic and total uranium concentration trends in both HU-A and HU-B unfiltered ground-water samples was conducted on available sampling data for the period from January 1999 through December 2002. The complete analysis is presented in USACE 2003d.

These trends were evaluated using Mann-Kendall testing. A Mann-Kendall trend analysis was conducted on those wells having at least seven sampling events and a greater than 80 percent detection frequency for the period January 1999 through December 2002. For arsenic, four HU-A wells (B16W04S, B16W06S, B16W07S and DW21) and seven HU-B wells (B16W07D, B16W08D, DW14, DW15, DW17, DW18, and DW19) were used. For total uranium, two HU-A wells (B16W12S, B16W13S) and three HU-B wells (DW16, DW17, and DW19) were used.

Mann-Kendall trend analysis indicated that only samples from HU-B well B16W07D are showing an upward trend for arsenic. The levels of arsenic in this well are below the investigative limit (50 µg/L). The Mann-Kendall statistical test does not take into consideration the range of error inherent in the analytical measurements. When the potential error in measurements is taken into account, the range associated with the arsenic values in B16W07D are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates that the determination of an overall trend for B16W07D is inconclusive.

The samples from the remaining HU-B wells show no arsenic trends. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for DW16. However, this test does not take into account the range of error associated in the analytical measurements. When the potential error in measurements is taken into account, the ranges associated with the total uranium values in DW16 are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates the overall trend for this well is inconclusive. The levels of total uranium in DW16 are below the IL (20 µg/L). It was determined that continued sampling would be necessary to determine if ongoing remedial actions will result in a decrease in uranium concentrations in HU-B ground-water samples (USACE 2003a).

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLDS are shown in Figure VI-9. Graphs for those HU-B wells exceeding the ILs [DW19 (total uranium) and DW14 and DW15 (arsenic)] are provided in Figure VI-10. These wells do not show statistically significant trends based on the Mann-Kendall test.

Wastewater and Storm-Water Discharge Monitoring

This section provides a description of the wastewater and storm-water monitoring activities conducted at the SLS during the five-year review period. The monitoring results obtained from these activities are presented and compared with their respective permit or permit-equivalent requirements. The purpose of wastewater and storm-water discharge sampling at the SLS is to monitor compliance with the established discharge requirements. These requirements are established by the following: MSD discharge authorization letter dated October 30, 1998, and modified in a letter dated July 23, 2001, for the SLDS; MDNR NPDES-equivalent document dated October 2, 1998, and a discharge authorization letter dated July 23, 2001 for the SLAPS; and MDNR NPDES permit number MO-0111252 for the HISS. The storm-water sampling results for the SLAPS and the HISS are evaluated against the requirements in 10 CFR 20.1302, 10 Code of State Regulations (CSR) 20-7.031, and permit requirements and conditions. Wastewater sampling results for the SLAPS and the SLDS are evaluated against 10 CFR 20.2003 requirements and requirements listed in the MSD discharge authorization letters for the SLDS (October 30, 1998 and July 23, 2001).

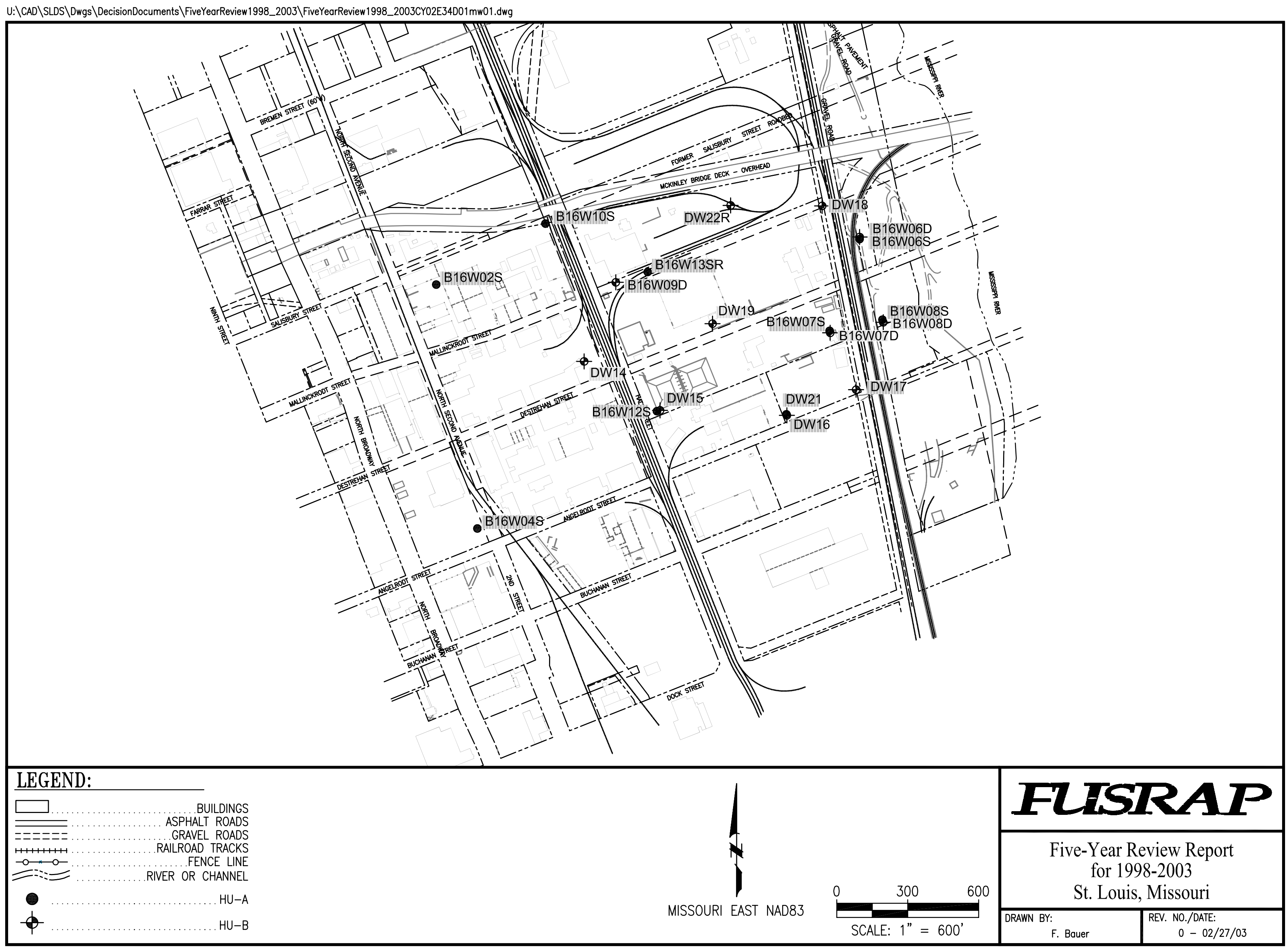


Figure VI-8. Ground-water Monitoring Well Locations at the SLDS in CY 2002

Wastewater Discharge Monitoring at the SLDS

Precipitation run-on and ground-water infiltration that collects in excavation areas of the SLDS are treated, if necessary, and discharged to the Bissell Point Sewage Treatment Plant under an authorization letter issued by the MSD.

There were no remedial-related discharges of storm water or ground water at the SLDS in CY1998. There were also no discharges during the first quarter of CY1999 due to the discovery of Civil War ordnance in the Plant 2 remediation area. Wastewater from the SLDS is discharged to MSD Base Map Inlet 17D3-022C. A summary of the wastewater discharges from the SLDS for the five-year review period is presented in Table VI-5. During three quarterly sampling events in 1999, gross beta values were observed at concentrations greater than the MSD authorization letter limit of 50 pCi/g. The elevated beta results were determined to be the result of the presence of naturally occurring K-40 in the water pumped from the excavations.

Table VI-5. Summary of Wastewater Discharges at the SLDS

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Activity Discharged	Total Volume Discharged
1998	No Discharge	No Discharge	No Discharge	No Discharge	0	0
1999	No Discharge	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Th – 1.65E-05 Ci U – 8.72E-06 Ci Ra – 2.75E-06 Ci	1,663,676 gallons
2000	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.15E-05 Ci U – 6.25E-06 Ci Ra – 3.07E-06 Ci	1,569,974 gallons
2001	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th –1.4E-05 Ci U – 4.5E-06 Ci Ra – 8.7E-06Ci	1,747,170 gallons
2002	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.1E-05 Ci U – 6.8E-06 Ci Ra – 1.8E-06 Ci	1,452,010 gallons

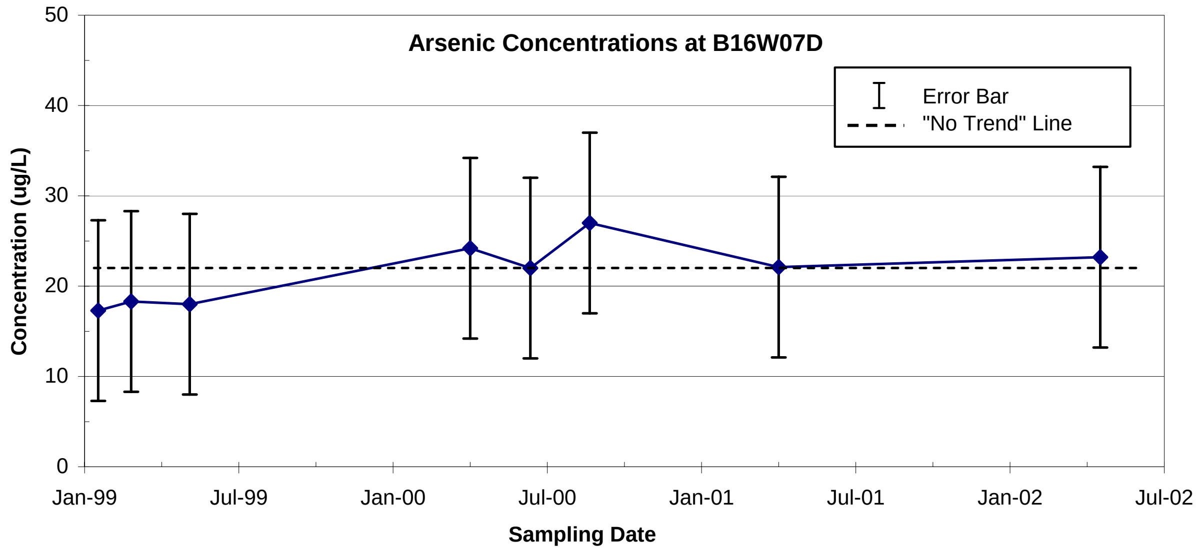
Wastewater Discharge Monitoring at the SLAPS

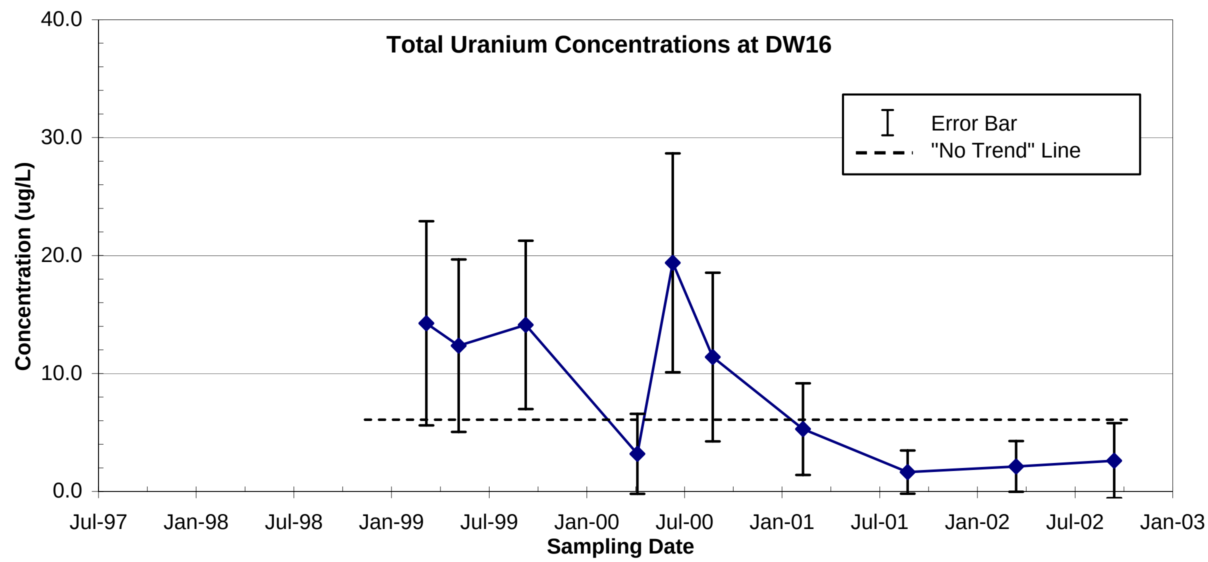
CY2002 was the first year that wastewater was discharged from the SLAPS to the sanitary sewer system. On July 23, 2001, the St. Louis MSD responded to a request by USACE to discharge treated wastewater to an MSD sanitary sewer located on-site by issuing a conditional approval for discharge of treated wastewater that resulted from USACE response actions at the SLAPS. The primary condition of the approval was that a treatment system be installed, maintained, and operated to produce an effluent meeting the standards contained in the following: MSD ordinance 8472, 10 CFR 20, and 19 CSR 20-10.

The MSD ordinance limits the annual allocation for radioactivity from the SLAPS to the MSD Coldwater Creek treatment plant, establishes the maximum volume of wastewater allowed to be discharged in a 24-hour period, and requires that the USACE show compliance of the treated wastewater with applicable standards and limits before MSD will allow the discharge.

During the second quarter of CY2002, a bench- and pilot-testing program of treating the wastewater by a bio-denitrification treatment system was initiated. A discharge line was installed from the wastewater treatment plant area to an MSD sewer line. During the third quarter, treatment of on-site stored wastewater was initiated. Four pilot-scale batches of wastewater were

Figure VI-9. Trend Analysis at the SLDS





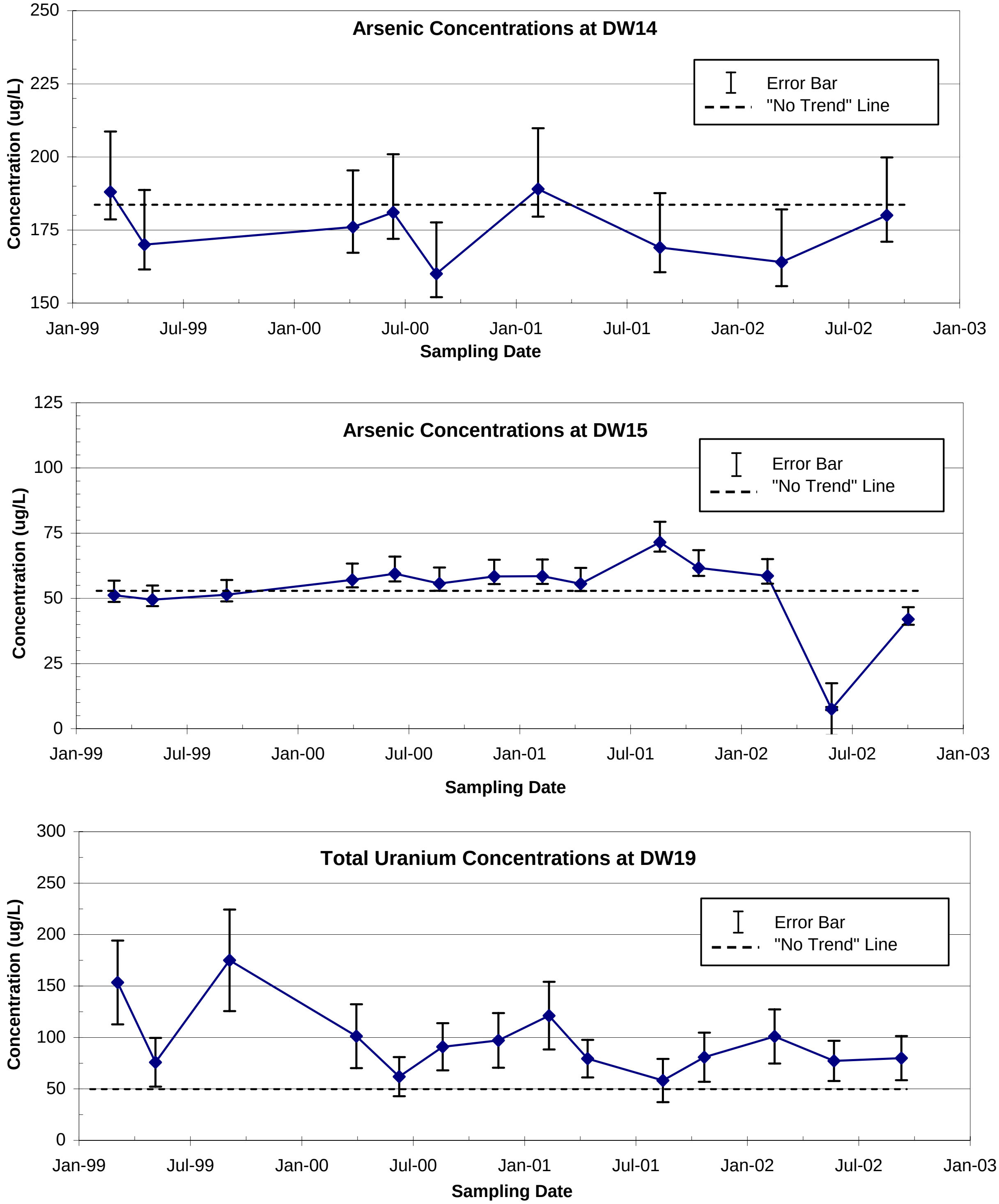
Notes:

For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-10. Trend Analysis for Wells Exceeding Investigative Limits (ILs) at the SLDS



Notes:

For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits of the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

treated and one full-scale batch was treated. The treated wastewater consisted of a first batch of 12,000 gallons (gal) of pilot-treated wastewater and a second batch of 120,000 gal of treated wastewater. These batches of treated wastewater were sampled and analyzed for MSD influent criteria. The results indicated a total activity of 1.4E-06 curies (Ci) for Th, 2.9E-06 Ci for uranium (isotopic method), and 0.0E+00 Ci for Ra.

Storm-Water Monitoring at the HISS

The MDNR renewed NPDES operating permit MO-0111252 for the discharge of storm water from two outfalls at the HISS in 1995. These outfall locations are designated as HN01 and HN02.

Both total suspended solids and pH values were within the discharge limits at both outfalls for the sampling events in CY1998. However, the maximum and mean gross alpha activities for both outfalls exceeded the ambient water quality criteria (AWQC) of 15 picocuries per liter (pCi/L). Additionally, the mean and maximum concentrations of Ra isotopes in the HN02 effluent exceeded the AWQC for combined Ra-226 and Ra-228 of 5 pCi/L. None of the AWQC for the chemical pollutants was exceeded. Furthermore, the measured concentrations of the detected organic pollutants were below the health advisory levels for bromacil (90 grams per liter) and AWQC for the phthalate esters of 10 CSR 20-7 for a drinking water supply.

Outfall HN03 was constructed in July 1999 to monitor storm-water run-off from the soil piles. CY1999 storm-water discharge concentrations from the HISS complied with criteria contained in the permit and 10 CFR 20.1302. The permit expired in 2000 and negotiations between the USACE and MDNR as to future activity under the permit are ongoing.

In CY2000 through CY2002, storm-water discharge was monitored from three outfalls at the HISS: HN01, HN02, and HN03. No permit limits or 10 CFR 20.1302 criteria were exceeded at the HISS in these calendar years.

Storm-Water Discharge Monitoring at the SLAPS

Site-specific permits are in place for the discharge of storm water to Coldwater Creek at the SLAPS. Historical monitoring of storm-water discharges at the SLAPS involved semiannual sampling of the effluent from two outfalls. The first of the SLAPS historical outfalls (STW-001) was located at the northwest entrance to the site, and the second historical outfall (STW-002) was located in the southwest corner of the site. As a result of insufficient flow, storm-water effluent samples were not collected from Outfall STW-002 during CY1998.

In a NPDES-equivalent document dated October 2, 1998, MDNR established storm-water discharge requirements for three outfalls at the SLAPS in conjunction with the proposed construction of the sedimentation basin. These three storm-water discharge outfalls at the SLAPS replaced the historical outfalls and were designated as Outfall PN01, Outfall PN02, and Outfall PN03. Outfall PN01 actually consists of two separate outfalls. Outfall PN01a is the discharge point for the sedimentation basin, and Outfall PN01b is the discharge point for the emergency spillway. Outfall PN01b is located near historical Outfall STW-001. Th-230 concentrations exceeded the values specified in Table 2, Appendix B of 10 CFR 20 of 15 pCi/L at each outfall in CY1998 with concentrations ranging from 1.33 to 320.3 pCi/L. (Thorium is not in the permit, and is based on annual averages per 10 CFR 20.)

In CY1999, storm-water discharge parameters were detected below discharge requirements, with one exception. Analytical results for the July 1, 1999, sample for Outfall PN03 indicated total copper at 101 µg/L, which is above the discharge limit of 84 µg/L. The CY1999 storm-water discharges from the SLAPS also complied with criteria contained in 10 CFR 20.1302. The average annual concentration of radioactive material released in CY1999 storm-water discharges did not exceed the values specified in Table 2, Appendix B of 10 CFR 20 (i.e., for a mixture of radionuclides, the SOR is less than unity).

For CY2000, storm-water discharge results indicated an exceedence of the discharge limit of 84 µg/L for total recoverable copper at Outfall PN03 in February 2000. The result reported was 88.6 µg/L. The CY2000 storm-water discharges from the SLAPS complied with the criteria contained in 10 CFR 20.1302.

Chemical sample data results for CY2001 storm-water discharges indicated there were two exceedences at Outfall PN03 of the discharge limit of 1.0 microliters per liter per hour (µL/L/hr) for settleable solids. These exceedences occurred in September and October 2001. The respective results were 1.56 µL/L/hr and 4.0 µL/L/hr. Both exceedences were the result of an intense rainfall event. The October 2001 result for Outfall PN03 revealed that the sample also exceeded the total recoverable copper limit of 84 µg/L with a result of 160 µg/L. The average annual concentration of radioactive material released in CY2001 storm-water discharges did not exceed the values specified in Table 2 of Appendix B of 10 CFR 20.

Discharge limits were exceeded for copper at Outfall PN01a during the second quarter of CY2002. The concentration of total recoverable copper (100 µg/L) exceeded the daily maximum limit of 84 µg/L. Otherwise, discharge limits were not exceeded at the SLAPS for CY2002.

Exceedances at the outfalls were detected after rainfall events that corresponded with backfilling operations. In addition, the exceedances that occurred in 2001 occurred when PN03 was plugged and water was being diverted to PN01a.

In accordance with a letter dated February 19, 2002, from MDNR, sampling at Outfall PN02 was reduced to once a year, until the drainage area is affected by a soil disturbance. Outfall PN03 has been discontinued as a sampling location in accordance with a letter by MDNR dated February 19, 2002.

Site Radiological Monitoring

Program Overview (SLDS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLDS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 millirem per year (mrem/yr) from all pathways, as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the total effective dose equivalent (TEDE) to the individual likely to receive the highest dose from the SLDS operations does not exceed the annual dose limit (100 mrem/yr).
2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 millirem per hour (mrem/hr).

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLDS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Table 2 of Appendix B, of 0.3 picocuries per liter (pCi/L) (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the effective dose equivalent (EDE) to a critical receptor. The National Emission Standards for Hazardous Air Pollutant (NESHAP) standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using thermoluminescent dosimeters (TLDs). TLDs at the SLDS were located at areas assumed to be representative of areas accessible to the public. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Gamma radiation was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The gamma radiation data collected from each location during CY1999 to CY2002 were corrected for background, shelter absorption, and fade and were normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation monitoring results are presented in Table VI-6.

Table VI-6. External Gamma Radiation Monitoring Results at the SLDS

Monitoring Location	Monitoring Station	CY1998 TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLDS	DA-1	NA	0	18	15	13
	DA-2	NA	0	2	9	13
	DA-3	NA	9	15	30	45
	DA-4	NA	0	6	18	18
	DA-5	NA	0	0	4	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLDS were used to calculate an average dose rate, and an annual deep dose equivalent (DDE) to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of calculated gamma radiation dose rates is presented in Table VI-7. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Table VI-7. External Gamma Dose Rate at the SLDS

	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Calendar Year Dose	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	NA	2	NA	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.0	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.

NA Not available

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1302(b)(1) limit of 100 mrem/yr during CY1999 to CY2002. The annual calendar year doses for CY1999 to CY2002 were less than the 100 mrem/year for all pathways.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLDS was far below the 10 CFR 20.1302(b)(2)(ii) limit for all years with negligible variance from year to year. There was a minute upward trend over the time period; however, when compared to the regulatory limit, the trend was insignificant.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that becomes suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in microcuries per milliliter (µCi/mL).

Perimeter air sampling for radiological particulates was not conducted at the SLDS during CY1998 to CY2002 due to the insignificant potential for material to become airborne at the site. Particulate air monitors were located at excavation perimeter locations on the SLDS. Air particulate samples are collected during active excavation at the SLDS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998 and CY1999.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY 1998 and CY1999, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-8.

Table VI-8. Air Particulate Monitoring at the SLDS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose Rate (mrem/yr)
1998	NA	NA	0.3
1999	NA	NA	0.8
2000	1.2E-14	1.3E-13	<0.1
2001	5.2E-15	6.0E-14	<0.7
2002	1.3E-15	2.3E-14	0.2

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLDS and the regulatory limits is presented in Table VI-9.

Table VI-9. Airborne Particulate Dose Rate at the SLDS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	*	10	100
1999	0.8	10	100
2000	<0.1	10	100
2001	<0.7	10	100
2002	0.2	10	100

* Value is less than 10 percent of the dose standard in 40 CFR 61.102.

As shown in Table VI-9, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLDS was far below the 40 CFR 61 standard and did not really vary from year to year. There is a small downward trend over the time period; however, when compared to the regulatory standard, the trend is insignificant. The average annual gross alpha and gross beta results demonstrate a slight downward trend over the period as well.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLDS using alpha track decectors (ATDs) to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Radon was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The radon data collected from each location during CY1999 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose rate. The calculated annual radon monitoring results are presented in Table VI-10.

Table VI-10. Radon Monitoring at the SLDS

Monitoring Location	Monitoring Station	CY1998 Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLDS	DA-1	NA	0.0	0.0	0.1	0.0
	DA-2	NA	0.0	0.0	0.1	0.0
	DA-3	NA	0.0	0.0	0.0	0.1
	DA-4	NA	0.0	0.0	0.0	0.0
	DA-5	NA	0.2	0.0	0.0	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Radon data from the SLDS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-11.

Table VI-11. Radon Concentration and Dose Rate at the SLDS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	NA	0.3	NA	100
1999	<0.1	0.3	0.0	100
2000	0.0	0.3	0.0	100
2001	<0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-11, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentrations at the SLDS were far below the 10 CFR 20 limit with negligible variance from year to year. There was a minute upward trend for dose rates over the time period; however, when compared to the regulatory limit, the trend was insignificant. The average annual concentration of radon remained approximately the same for the period.

Site Radiological Monitoring

Program Overview (SLAPS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLAPS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the SLAPS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLAPS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the SLAPS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade, and was normalized to exactly one year for the purpose of comparison to an annual dose. The calculated annual gamma radiation results are presented in Table VI-12.

Table VI-12. External Gamma Radiation Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLAPS	PA-1	NA	47	112	162	157
	PA-2	32	7	6	14	14
	PA-3	74	8	31	60	58
	PA-4	2450	330	142	58	45
	PA-5	47	30	27	13	7
	PA-6	NA	89	106	105	108

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLAPS was used to calculate an average dose rate and an annual DDE to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates are presented in Table VI-13.

Table VI-13. External Gamma Dose Rate at the SLAPS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	0.3	2	0.1	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.1	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLAPS was far below the 10 CFR 20 limit for all years with negligible variance from year to year.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the SLAPS during CY1999 to CY2002. Air particulate samples were collected weekly at the SLAPS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-14.

Table VI-14. Air Particulate Monitoring at the SLAPS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	7.6
1999	2.3E-15	3.5E-14	6.4
2000	3.5E-15	4.1E-14	6.4
2001	5.6E-15	6.3E-14	9.4
2002	3.1E-15	4.2E-14	4.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLAPS to the regulatory standards is presented in Table VI-15.

Table VI-15. Airborne Particulate Dose Rate at the SLAPS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	7.6	10	100
1999	6.4	10	100
2000	6.4	10	100
2001	9.4	10	100
2002	4.8	10	100

As shown in Table VI-15, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLAPS was below the 40 CFR 61 standard for all years. There is an overall slight downward trend during the time period. The average annual gross alpha and gross beta results have remained approximately the same over the period. This may be due to ongoing remediation at the SLAPS.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLAPS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-16.

Table VI-16. Radon Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLAPS	PA-1	NA	0.6	0.1	0.2	0.1
	PA-2	0.2	0.0	0.0	0.1	0.1
	PA-3	0.2	0.1	0.0	0.0	0.0
	PA-4	0.4	1.5	0.3	0.1	0.1
	PA-5	0.2	0.0	0.2	0.0	0.0
	PA-6	NA	0.0	0.0	0.2	0.0

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored

Data Analysis

Radon data from the SLAPS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-17.

Table VI-17. Radon Concentration and Dose Rates at the SLAPS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	<0.2	0.3	NA	100
1999	0.37	0.3	0.0	100
2000	0.1	0.3	0.0	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-17, the average annual concentrations above background during CY1999 and CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L with the exception of 1999. Although the average annual radon concentration exceeded the Appendix B value in 1999, compliance with the 10 CFR 20 limit of 100 mrem/yr was demonstrated through calculation of the TEDE to the individual likely to receive the highest dose.

Five-year Trend Analysis

The annual radon concentrations at the SLAPS were below the 10 CFR 20 limit with negligible variance from year to year (with the exception of 1999). There was no apparent trend for annual dose over the time period. The average annual concentrations of radon had a slight downward trend for the period.

Site Radiological Monitoring

Program Overview (HISS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, radon, and radon flux data. The data were used to assess the magnitude of radiological exposures to the general public.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the HISS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the HISS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr, as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

40 CFR 192

40 CFR 192 requires control of residual radioactive materials to provide reasonable assurance that releases of radon-222 (Rn-222) will not exceed an average release rate of 20 picocuries per square meter per second (pCi/m^2/s). Radon flux data from the piles on the HISS were used to calculate an average radon release rate to compare to the 40 CFR 192 limit and to verify the liner over the piles was effectively intact.

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the HISS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade and was normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation results are presented in Table VI-18.

Table VI-18. External Gamma Radiation Monitoring at the HISS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
HISS	HA-1	0	0	11	110	90
	HA-2	59	52	51	66	49
	HA-3	101	37	42	76	20
	HA-4	43	47	59	94	NA
	HA-5	NA	NA	32	9	4
	HA-6	0	0	0	2	1
	1	27	NA	NA	NA	NA
	5	24	35	NA	NA	NA
	8	0	NA	NA	NA	NA

a Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the HISS were used to calculate an average dose rate and an annual EDE to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates is presented in Table VI-19.

Table VI-19. External Gamma Dose Rate at the HISS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	<0.1	2	0.3	100
1999	<0.1	2	0.2	100
2000	<0.1	2	0.2	100
2001	<0.1	2	0.2	100
2002	<0.1	2	0.1	100

a Calculated by dividing the annual gamma radiation result by 8760 hours for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the HISS was far below the 10 CFR 20 limit for all years with negligible variance from year to year. The annual dose had a slight downward trend over the period.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the HISS during CY1999 to CY2002. Air particulate samples were collected weekly at the HISS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-20.

Table VI-20. Air Particulate Monitoring at the HISS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	0.1
1999	2.1E-15	3.5E-14	0.8
2000	2.0E-15	3.1E-14	2.1
2001	2.0E-15	2.9E-14	7.8
2002	1.7E-15	2.5E-14	7.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the HISS and the regulatory limits is presented in Table VI-21.

Table VI-21. Airborne Particulate Dose Rate at the HISS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	0.1	10	100
1999	0.8	10	100
2000	2.1	10	100
2001	7.8	10	100
2002	7.8	10	100

As shown in Table VI-21, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the HISS was below both the 40 CFR 61 standard for all years. There is an overall upward trend during the time period. This may be due to active remediation in CY2000 and CY2001. The average annual gross alpha and gross beta results had a slight downward trend over the period. CY2002 gross alpha and gross beta results were less than the respective CY2001 results indicating that there may be lower airborne particulate emissions after the HISS piles had been removed in CY2000 and CY2001.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the HISS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Radon flux sampling was used to measure emission rates of radon from the surface of the contaminated soil piles. Radon flux monitoring was performed using 10-inch diameter activated charcoal canisters placed on a pre-determined grid. The canisters were attached to the storage pile’s cover surface for 24 hours, and then the canisters were retrieved and sent to an off-site laboratory for analysis in accordance with Appendix B of 40 CFR 61. Radon flux monitoring was performed at the HISS piles during CY1998 through CY2000. The piles were remediated during CY2000 and CY2001 and radon flux monitoring was no longer required.

Perimeter Radon ATDs

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and were normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-22.

Table VI-22. Radon Monitoring at the HISS

Monitoring Location	Monitoring[a] Station	CY1998 ATD Data (mrem/yr)	CY1999 ATD Data	CY2000 ATD Data	CY2001 ATD Data	CY2002 ATD Data
HISS	HA-1	0.2	0.0	0.2	0.2	0.0
	HA-2	0.2	0.0	0.0	0.1	0.0
	HA-3	0.2	0.1	0.0	0.0	0.1
	HA-4	0.2	0.0	0.1	0.1	NA
	HA-5	NA	NA	0.0	0.1	0.0
	HA-6	0.2	0.0	0.0	0.0	0.0
	1	0.2	NA	NA	NA	NA
	5	0.2	0.0	NA	NA	NA
	8	0.2	NA	NA	NA	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored

Data Analysis

Radon data from the HISS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates are presented in Table VI-23.

Table VI-23. Radon Concentration and Dose Rate at the HISS

Calendar Year	Average Annual Concentration Above Background (pCi/L)	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate (mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
1998	0.2	0.3	NA	100
1999	<0.1	0.3	0.2	100
2000	<0.1	0.3	0.4	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.1	100

NA Not available

As shown in Table VI-23, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentration at the HISS was below the 10 CFR 20 limit with negligible variance from year to year. There was a slight downward trend for annual dose over the time period. The average annual concentration of radon also had a slight downward trend for the period.

Radon Flux

Monitoring Program Results

The radon flux data collected from each location on the HISS piles during CY1998 to CY2000 were used to calculate an average radon release rate for the site. The calculated average radon release rates are presented in Table VI-24. Removal of the HISS stockpiles was conducted during 2001.

Data Analysis

Radon release rate data from the HISS were compared to the 40 CFR 192 limit of 20 pCi/m^2/s. A summary of the radon flux monitoring is presented in Table VI-24.

Table VI-24. Radon Release Rate at the HISS

Calendar Year	Average Radon Release Rate	10 CFR 20 App. B (20 pCi/m^2/s)
	(pCi/m^2/s)	
1998	0.4	20
1999	1.3	20
2000	0.9	20

As shown in Table VI-24, the average radon release rate from the site did not exceed the 40 CFR 192 limit of 20 pCi/m^2/s during CY1998 to CY2000.

Five-year Trend Analysis

The average radon release rate at the HISS was far below the 40 CFR 192 limit with negligible variance from year to year. There was no apparent trend for the average radon release rate over the time period. These data indicate that the liner was effective at controlling the potential release of radon.

Confirmatory Soil Sampling Program

Final status survey confirmatory sampling has been conducted at properties where removal or remedial actions have taken place. The purpose of this confirmatory sampling is to demonstrate that the removal or remedial action has been completed and the residual contamination is below the removal or remedial goal. The USACE evaluates the results to ensure the residual concentrations in the excavation meet the SLDS ROD remediation criteria for the SLDS properties, and the removal action criteria in the applicable EE/CA for the North St. Louis County sites properties. The following table summarizes SLS completed actions:

Table VI-25. SLS Confirmatory Soil Sampling Program Completed Actions

Site	Location	Document	Completed Action
North St. Louis County	SLAPS-VP St. Denis St. Bridge	Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	The USACE informed the City of Florissant that the soil with residual radioactive contamination above criteria in the areas impacted by the new bridge installation had been removed.
SLDS	DT-1 Archer Daniels Midland (ADM) VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1)(USACE 2002b)	No removal action required; the property was released without radiological restrictions.
SLDS	DT-15 City Owned Metropolitan Sewer District (MSD) Salisbury Lift Station VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site City- Owned Property North (MSD) Salisbury Lift Station Vicinity Property(USACE 2001f).	No removal action required; the property was released without radiological restrictions.
SLDS	Mallinckrodt Plant 2	Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property (USACE 2002a).	Residual radioactivity in the accessible areas in Plant 2 met the requirements of the remedial design and was below the 15/15/50 SLDS ROD remediation criteria. In addition, analytical results for arsenic and cadmium were below the SLDS remediation criteria.
North St. Louis County	SLAPS-VP IA-9	St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), (USACE 2000c).	

A complete discussion of confirmatory sampling conducted at the following locations will be included in the next five-year report. This will inlcude:

<u>SLDS</u>
Mallinckrodt Plant 1
Mallinckrodt Plant 6E and 6EH
Mallinckrodt Plant 7E
Midwest Waste Vicinity Property (DT-7)
Heintz Steel and Manufacturing Vicinity Property (DT-6)

<u>North St. Louis County Sites</u>
SLAPS Radium Pits, East End, East End Extension / ROW and Phase 1 work areas
SLAPS sedimentation basin
SLAPS North Ditch
HISS, including stockpiles
SLAPS VP-38

Surface-water and Sediment Monitoring Program

Monitoring Overview

The environmental monitoring plan of Coldwater Creek evaluates the physical, radiological, and chemical parameters present in Coldwater Creek's surface water and sediment. The radiological and chemical parameters to be monitored were based on the Environmental Monitoring Plan for the SLS and are not necessarily FUSRAP COCs. The monitoring programs are conducted at Coldwater Creek as a part of the SLS to meet several objectives. These objectives are:

- To assess the quality of surface water and sediment at Coldwater Creek
- To compare the sampling results with regulatory standards or background values
- To evaluate/determine whether run-off from the SLAPS, the HISS, and their vicinity properties contribute to the quality of surface water and sediment in the creek.

Sampling of Coldwater Creek's surface water and sediment is conducted semi-annually at six monitoring stations (C002 through C007).

Monitoring Program Results

The evaluation results for the surface water and sediment sampling data for Coldwater Creek from CY1998 to CY2002 are presented in the following section. The sampling locations along Coldwater Creek are shown on maps included in the Annual Environmental Data Analysis Reports.

CY1998 Coldwater Creek Sampling Event

One sampling event was conducted for both surface water and sediment at all six monitoring stations during CY1998. For surface water, the maximum concentrations of Ra-226 and Th-230 occurred at monitoring station C004 and C005, respectively. However, the results were below the corresponding background values. The maximum concentrations for uranium isotopes were detected at C004 (16.03 pCi/L).

For sediment, the concentrations of Ra-226, Th-230, and U-238 ranged from 0.96 pCi/g to 5.14 pCi/g, 1.61 pCi/g to 201.2 pCi/g, and 1.92 pCi/g to 7.16 pCi/g, respectively. The maximum concentrations for these radionuclides occurred at C005.

Ra-226 concentration exceeded its background criteria of 4.73 pCi/g at station C005. For Th-230, the background criteria (2.2 pCi/g) was exceeded at stations C003, C004, C005, and C007. However, U-238 concentrations did not exceed its background criteria of 4.3 pCi/g at any monitoring station.

CY1999 Coldwater Creek Sampling Event

One sampling event for surface water was conducted as part of the Ecological Risk Assessment for North St. Louis County sites during CY1999. Only two sampling stations (C002 and C003) were sampled. The maximum concentrations of Th-230 and uranium isotopes were detected at

C003. Among chemicals, the concentrations of iron and zinc were higher than respective background values at station C003.

One sediment sampling event was conducted at six monitoring stations during CY1999. Among radionuclides, Ra-226 was detected and exceeded its background criteria at station C007. The concentrations of Th-230 were above background at stations C003, C004, and C007, and the maximum concentration was detected at C007. However, the concentrations of uranium isotopes were less than their corresponding background levels. Among chemicals, background criteria for eight inorganic analytes (beryllium, boron, calcium, chromium, copper, lead, sodium, and thallium), and thirteen semi-volatile organic analytes were exceeded.

CY2000 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2000. Ra-226 was not detected during either surface water sampling event in CY2000. The maximum concentration of Th-230 was detected at C007 during the first sampling event, whereas the maximum concentrations of uranium isotopes were detected at C002, during the second sampling event. However, the maximum concentrations were below corresponding background values. No chemical exceeded its corresponding AWQC during the first surface water sampling event. During the second sampling event, aluminum and iron exceeded their corresponding AWQCs.

The maximum concentrations of Ra-226 and Th-230 were detected at C005 during the first CY2000 sediment sampling event. The results exceeded their corresponding background values. The maximum concentrations of uranium isotopes were below their corresponding background values.

CY2001 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2001. Ra-226 was not detected during either surface water sampling event of CY2001. Th-230 was detected only at C004 (1.39 pCi/L). The maximum concentrations for uranium isotopes occurred at sampling station C003 during the first sampling event. However, the maximum concentration was less than the background concentration. Zinc was the only chemical that exceeded the corresponding surface water background values during both sampling events. The concentration of zinc was below its AWQC.

The maximum concentrations of Ra-226, Th-230, and U-238 were detected at C005 during the CY2001 sediment sampling event. Except for Th-230, maximum concentrations did not exceed background values. Four inorganics, sixteen semi-volatile organics, and one volatile organic analyte (methylene chloride, a common laboratory contaminant) were detected during CY2001 sediment sampling events.

CY2002 Coldwater Creek Sampling Event

Two surface water sampling events were conducted in CY2002. Ra-226 was not detected during the CY2002 surface water sampling events. The maximum concentrations of Th-230 and uranium isotopes were detected at C007; however, their results are below their corresponding background levels. Manganese, nickel, and selenium exceeded their corresponding background values during the first sampling event. The concentrations of aluminum, arsenic, selenium, and zinc exceeded background values during the second sampling event.

Ra-226 only exceeded its background values at C007 during the first sediment sampling event. However, during the second sampling event, Ra-226 concentrations exceeded its background values at all downstream stations. Th-230 concentrations exceeded background values at four downgradient stations (C004, C005, C006, and C007) and three downstream stations (C003, C005, and C007) during the second sampling event. U-238 concentrations exceeded background values for all downstream stations and the maximum concentration was detected at C007 (1.19 pCi/g). Arsenic, manganese, and magnesium exceeded background values during both sampling events, whereas concentrations of thallium and cadmium exceeded background values during the first and second sampling event, respectively.

Five-Year Trend Analysis

Figure VI-11 represents the five-year concentration trend analysis for different radionuclides in surface water. Among different radionuclides, concentrations of Ra-226, Th-230, and total uranium at all monitoring stations were analyzed for the last five years. Figure VI-11 (Trend Analysis for Ra-226) showed that the concentrations of Ra-226 did not exceed its AWQC (5 pCi/L) during the last five years at any of the stations; however, the concentrations at each station were above its background criteria during different times within this five-year period. The maximum concentration of Ra-226 was detected at monitoring station C003 during the first sampling event of CY2000. The trend showed that Ra-226 concentrations have been decreasing at each of the monitoring stations during the last three years. Figure VI-11 (Trend Analysis for Th-230) presents the trend of Th-230 concentrations at each monitoring station during the last five years. Except for the CY1999 sampling event, the concentrations of Th-230 have not exceeded its background value during the last five years. The total uranium concentrations during the last three years has not exceeded its background value, as shown in Figure VI-11 (Trend Analysis Per Total Uranium). Negative bar graphs indicate that the concentrations were below background levels. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

Figure VI-12 represents the five-year concentration trend analysis for different radionuclides in sediment. Figure VI-12 (Trend Analysis for Ra-226) shows the trend of Ra-226 concentrations at each monitoring station during the last five years. However, the chart did not include the results of detected maximum concentrations of Ra-226 (March 2000 sampling event) in order to better present the trend of Ra-226 concentrations at other stations. The chart showed that the concentrations of Ra-226 are less than their background level at all stations except for C005. In addition, the recent concentrations of Ra-226 showed that the concentrations are around its background level at all monitoring stations. As in the first chart, the second chart of Figure VI-12 (Trend Analysis for Th-230) did not include the result of the detected maximum concentration of Th-230 at C005 (CY1998 sampling event) in order to better present the trend of Th-230 concentrations at other monitoring stations. The chart showed that Th-230 concentrations are consistently higher at station C007, with respect to other stations. An elevated concentration of Th-230 was detected at C005 during the CY2002 sampling event. Figure VI-12 (Trend Analysis of Total U) showed that the total uranium concentrations in the sediment at all monitoring stations have decreased during the last three years. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

In addition to the trend analysis, an analysis was performed to correlate the concentrations of the radionuclide COCs (Ra-226, Th-230, and Total U) in the surface water with the concentrations of the same in the sediments at the same location by using historic results. The non-parametric Mann-Whitney method was used to determine the correlation. Based on 95% confidence interval, a null hypothesis was assumed. According to the hypothesis,

$H_0 : \lambda 1 = \lambda 2$, versus $H1: \lambda 1 \neq \lambda 2$, where λ is the population medium.

The results of the analysis showed that for Ra-226 and Th-230, a correlation exists between surface water and sediment concentrations at all monitoring stations. For total uranium, there is a correlation between surface water and sediment concentrations at monitoring stations C004, C005, and C007. This correlation indicates that concentrations of COCs in the sediment are impacting the surface water quality.

SITE INSPECTIONS

The purpose of the site inspections was to gather information about the SLS status and visually confirm and document the impact of the response actions on the site and the surrounding areas. Because of the size of the SLS and the distance between them, separate inspections were conducted for the North St. Louis County sites (the SLAPS, HISS, and SLAPS VPs) and the SLDS. The completed checklists are provided in Appendix C.

Hazelwood Interim Storage Site

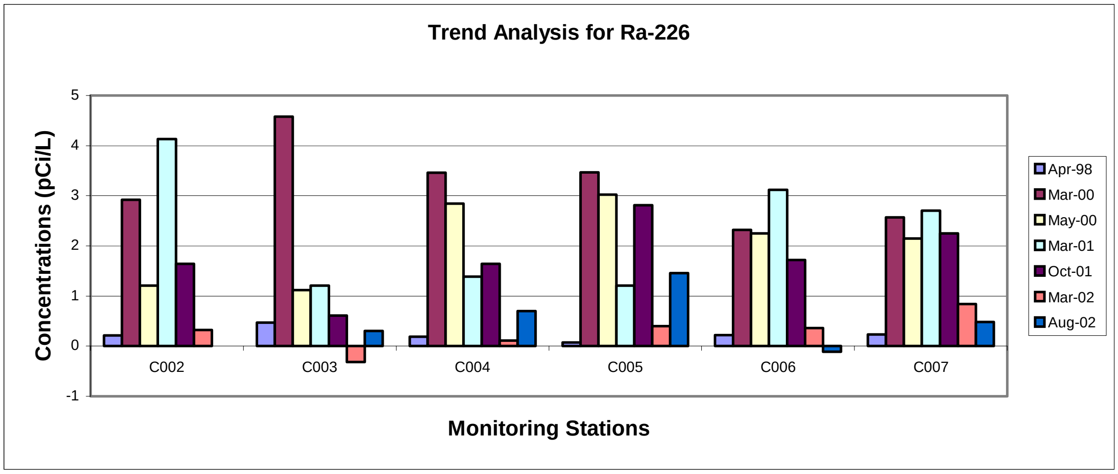
The HISS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Dave Mueller, the USACE-Area Engineer.

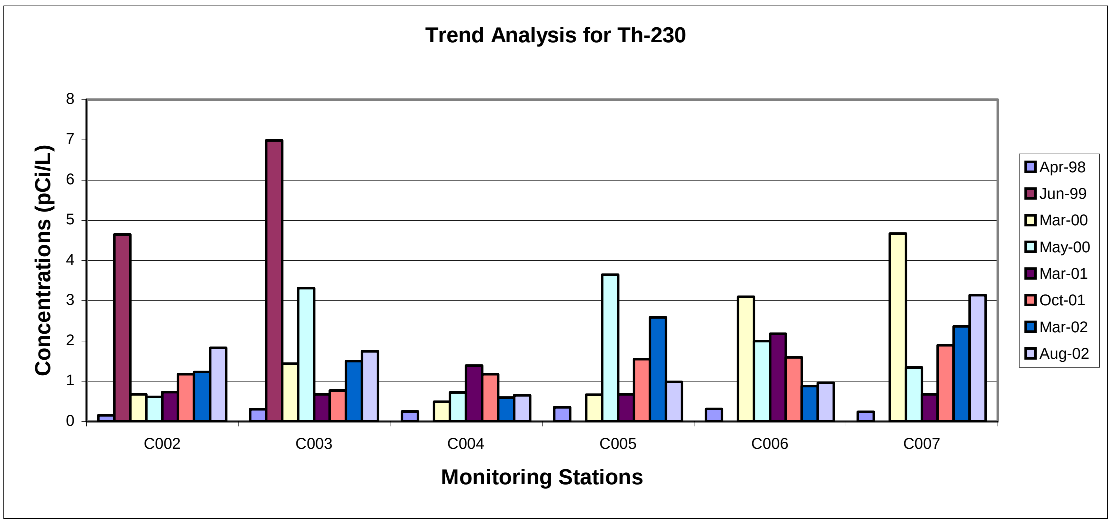
The inspection began with a discussion with Mr. Mueller about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. Since the removal of the piles was completed in CY2002, maintenance and environmental monitoring were the only remedial activities taking place on the site.

During the physical inspection the team was escorted by Bob Wasitis (USACE), the site representative, chosen for safety and his knowledge of the HISS. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on general site conditions, access control facilities, and environmental monitoring equipment related to removal actions.

Although there were no significant issues identified by the team, the access control and monitoring stations for air and storm-water run-off were in place and appeared to be functioning properly. Most of the site was well covered with vegetative growth and geofabric covered by rock; however, the team noted a minor (potential) issue in that the vegetation in the northern area of the property was sparse and rock had been displaced, exposing the geofabric in some areas. The team also noted that the site drainage pattern impeded the growth of vegetation despite regular attempts at seeding the area; this could cause dust to become airborne and should be addressed to avoid potential fugitive dust emissions. It should be noted that there have been no emissions of fugitive dust to date, and ongoing air monitoring has not indicated fugitive dust to be an issue.

Figure VI-11. Trend Analysis for Radionuclides in Coldwater Creek Surface Water





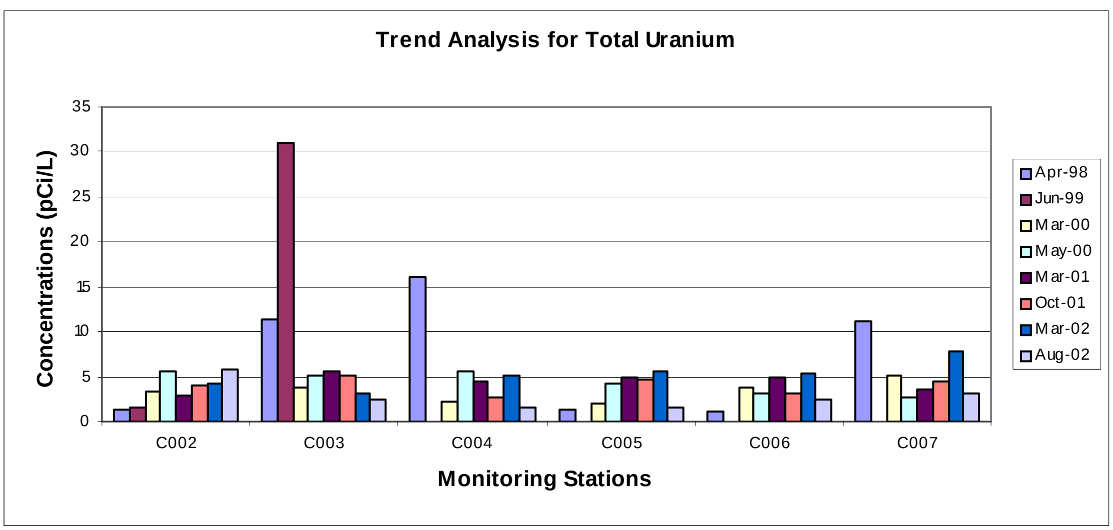
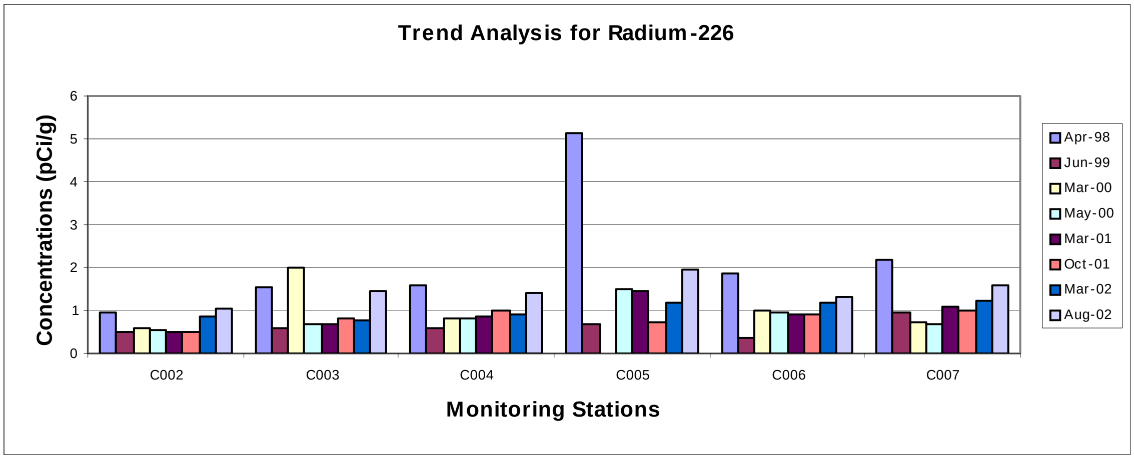
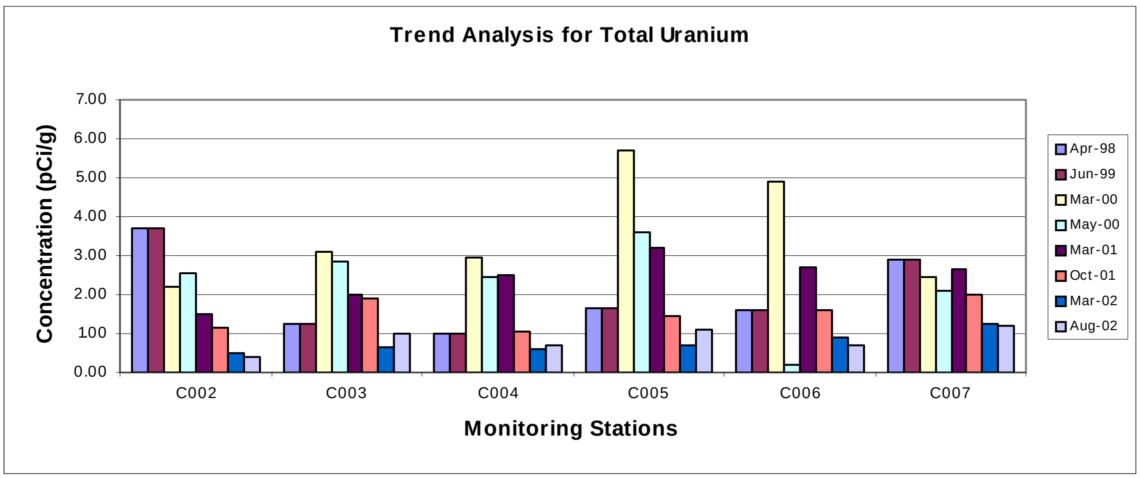
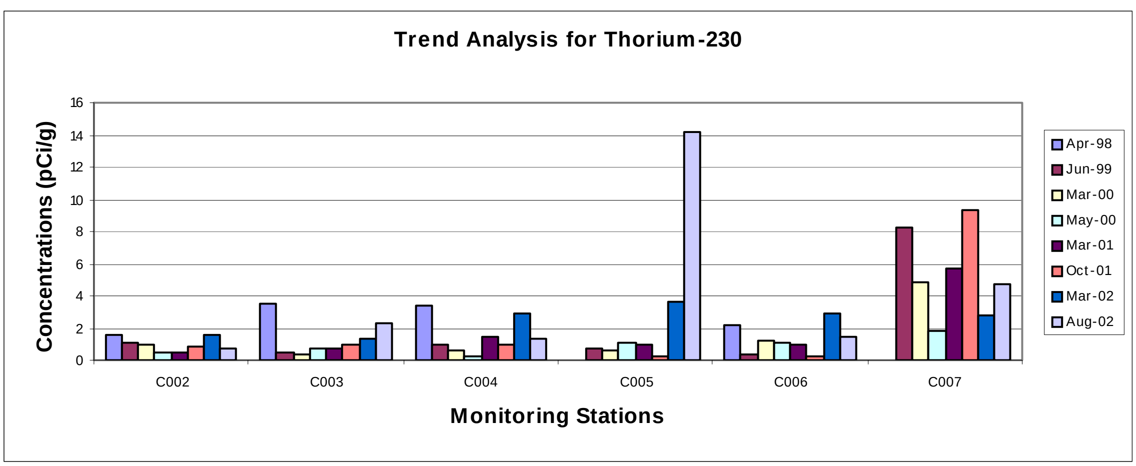


Figure VI-12. Trend Analysis for Radionuclides in Coldwater Creek Sediment







St. Louis Airport Site

The SLAPS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. McKinley, (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Sonny Roberts, the USACE-SLAPS Construction Manager.

The inspection began with a discussion with Mr. Roberts about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Excavation in the McDonnell Boulevard ROW
- Excavation in the Phase 1 area of the SLAPS
- Excavation in the Phase 2 area of the SLAPS
- Pumping of ponded water to holding basins for treatment
- Loading railroad cars with contaminated materials for shipment

During the physical inspection, the team was escorted by Corey Harris (SHAW) chosen for safety and his knowledge of the SLAPS. The site is an open area north of Lambert-St. Louis International Airport; the eastern portion is covered by facilities and parking areas for the remediation. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to the removal actions, and on-going removal work.

No significant issues were identified regarding the removal action being implemented at the SLAPS. Access control and environmental monitoring equipment were in place around the perimeter of the site and of the excavations, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas. Vegetative cover had been properly established as part of the final restoration for previously addressed areas and for areas not yet remediated.

North St. Louis County sites VPs

The SLAPS VPs were inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Dave Mueller, the USACE-Area Engineer, and the inspection began with a discussion with Mr. Mueller about site activities. The VPs are in a maintenance mode pending selection of the final remediation goals, so, aside from support to utilities and/or property development, no activities were taking place.

Because the VPs are privately owned and largely observable from public roads, the team performed its physical inspection of the properties unescorted. Affected properties were observed during a driving tour of the original haul routes, and the inspection was limited to general site conditions such as the presence of vegetative cover.

No significant issues were identified by the team regarding the response actions being implemented for the VPs. The primary activity for these properties is the communication regarding contaminant location and requests by the property owners for support during property improvements. Regular site inspections by USACE-CEMVS personnel and self-reporting by utility and property owners has helped assure that the properties are being properly addressed.

Building expansions were evident on properties VP-24 and VP-36; these construction activities had been supported by USACE-CEMVS. The inspection team also noted traffic ruts in shoulders of roadways and recommended continued monitoring and support as appropriate, since repairs could pose a health risk or move contamination to previously uncontaminated areas. The team also recommended updating VP contamination status maps so that cleared areas, contaminated areas, and questionable areas are clearly identified and land-use changes are recorded.

St. Louis Downtown Site

The SLDS was inspected on May 8 and 9, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Wade (MDNR). The team was met by Gerald Allen, the USACE-SLDS Construction Manager, who escorted them throughout the investigation for safety and knowledge of the SLDS.

The inspection began with a discussion with Mr. Allen about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Remedial excavation at Mallinckrodt Plant 6 East Half;

- Remedial excavation at Heintz Steel and Manufacturing VP (DT-6); and

- Construction activities underway on that portion of the property leased from PSC Metals. Construction activities were limited to the north side of the loadout facility to construct additional loadout capacity at the SLDS.

The physical inspection consisted of a tour of the site. Most of the VPs were visited. As would be expected in an area of mature industrialization, the SLDS is dominated by active manufacturing plants, warehouses, outdoor storage areas, roadways, and railways in various states of repair. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to remediation, and on-going remedial work.

No significant issues were identified regarding the remedial action being implemented at the SLDS. Access control measures appeared to be appropriate for the excavations at Plant 6 and Heintz Steel. Monitoring devices were in place around the perimeter of the site, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas.

Interviews

In April and May 2003, the USACE conducted 30 St. Louis Sites community interviews. These interviews were conducted as a part of the FUSRAP five-year review. Respondents included property owners; business owners; city, county, state and federal elected officials; utility company representatives; citizen interest groups (e.g. St. Louis Oversight Committee, Gracehill); residents not otherwise affiliated with interest groups; local school officials; state and local government agency representatives; and community religious leaders.

Respondents generally reported feeling well informed of the site activities and progress. They reported they were satisfied with the current communication plan (means and frequency of information distribution through various meetings, newsletters, and news releases) and the USACE's responsiveness to community concerns. Currently, community concern about contamination from the St. Louis Sites is moderate, which does not mean that citizens are indifferent to the environmental problem posed by the sites. On the contrary, conversations with community members have revealed that many stakeholders are keenly interested in site response actions and regularly check the continued progress of cleanup activities.

Many of the people interviewed also expressed satisfaction with the progress of cleanup activities at the FUSRAP sites as well as USACE's openness in sharing information regarding site activities and efforts to build relationships with the various entities impacted the project. A summary of concerns and other related issues raised during the interviews follows.

Primary Concerns Raised During the Interviews

Contaminant Migration Issues: The public expressed concerns regarding the migration of contamination during cleanup activities. USACE should continue to take appropriate steps to minimize the potential for contaminant migration.

Inaccessible Soil and LTS Issues: Utility companies expressed concerns about whether the existing utility support agreements will be honored in the future after active remediation is complete. The current agreement provides utilities with a sense of security and reassurance that their people will be supported during work in impacted areas. State and local representatives wanted broader community involvement in the development of the final LTS plan for the various sites to ensure stewardship requirements fit the current and planned future land use.

Other Important Issues Raised by the Community

The CERCLA Cleanup Process: The community relations program at the St. Louis Sites should continue to educate area residents and local officials about the procedures, policies, and requirements of the Superfund program. The community expressed great satisfaction with past education efforts and encouraged continuation of this effort.

The Pace of the Community Relations Program: The pace of the community relations program will be set by the needs of the local stakeholders. Community relations activities will be set up to encourage community participation. Stakeholders have requested continuation of the following communication methods to relate information about progress and problems encountered during cleanup efforts: telephone contacts, letters, reports, newsletters, Internet resources, and regularly scheduled meetings with citizen groups.

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